New York State Department of Environmental Conservation

Buffalo River Remedial Action Plan

November 1989

This Buffalo River Remedial Action Plan was prepared by the New York State Department of Environmental Conservation in cooperation with the Buffalo River Citizens' Committee.

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BUFFALO RIVER REMEDIAL ACTION PLAN
EXECUTIVE SUMMARY

This report is in response to a recommendation of the Water Quality Board of the International Joint Commission that Remedial Action Plans (RAPs) be prepared for the 42 Areas of Concern in the Great Lakes Basin. The Buffalo River is one of six Areas of Concern in New York State. The Buffalo River RAP is a joint product of the New York State Department of Environmental Conservation and the Buffalo River Citizens' Committee, a group representing environmental, academic, and local government interests appointed by the Department. It was prepared with the assistance and participation of many representatives of local, state, and federal government, business, and private citizens.

RAP GOAL

The immediate goal of the RAP is to restore and maintain the chemical, physical, and biological integrity of the Buffalo River ecosystem in accordance with the Great Lakes Water Quality Agreement. Support of fishing and aquatic life have been established as the best uses of the Buffalo River through a public process under the New York State Stream Classification System. The RAP is designed to restore these uses where they have been impaired and to move toward the elimination of all sources of pollutants.

PROBLEMS AND CAUSES

The Buffalo River and its sediments have been polluted by past industrial and municipal discharge and disposal of waste. Fishing and survival of aquatic life within the Area of Concern have been impaired by PCBs, chlordane, and polynuclear aromatic hydrocarbons (PAHs). Fish and wildlife habitat have been degraded by navigational dredging of the river and by bulkheading and other alterations of the shoreline. Low dissolved oxygen and DDT are likely causes of aquatic life degradation, but they have not yet been definitely established as such. In addition, metals and cyanides in the sediment prevent open lake disposal of bottom sediments dredged from the river.

SOURCES OF PROBLEMS

Contaminated bottom sediments are the one certain source of pollutants causing impairments. Other sources have been identified as potential sources because the pollutants causing impairments are known to exist at these locations, but the link between the source and the impairment has not been clearly established. The potential sources include inactive hazardous waste sites, combined sewer overflows, and other point and nonpoint sources of pollution.

REMEDIAL OBJECTIVES AND RECOMMENDATIONS

A comprehensive and focused strategy has been developed to:

- remediate the bottom sediments;
- establish a river monitoring program that will determine whether potential sources contribute to impairments;
- continue the on-going programs that remediate inactive hazardous waste sites, control point source discharges, and manage nonpoint sources; and
- improve fish and wildlife habitat.

The recommended program is:

REMEDIATE BOTTOM SEDIMENTS

Objective:
Correct the impairments to the Buffalo River's fishery and aquatic life caused by contaminated sediments.

Recommendation:
1. Develop a model of sediment flow and deposition in the Buffalo River in order to determine the potential for armoring layers to be established over the contaminated sediments in certain sections of the river.

2. Develop sediment criteria that will allow decisions to be made about which particular bottom sediments are causing impairment of the fishery and aquatic life.

3. Assess the river sediments based on criteria to determine specific areas of the river where remedial work is needed.

4. Evaluate removal/armoring alternatives and then carry out appropriate remedial work.

IMPROVE STREAM WATER QUALITY MONITORING

Objective:
Ensure that all sources have been addressed in the remedial action plan.

Recommendation:
1. Establish an automated sampling station on the Buffalo River so that the amounts of contaminants of concern can be accurately determined.

2. Develop models to relate amounts of contaminants in the river to their potential for harming fish or aquatic life.

Objective:
Determine whether low dissolved oxygen in the Buffalo River is likely to impair the fishery.

Recommendation:
Carry out an intensive dissolved oxygen study.

REMEDIATE INACTIVE HAZARDOUS WASTE SITES

Objective:
Prevent inactive hazardous waste sites from contributing contaminants to the river.

Recommendation:
Continue the on-going program for remedial work in the Buffalo River drainage area with particular attention to protecting the Buffalo River itself.

REMEDIATE OTHER NONPOINT SOURCES AS NECESSARY

Objective:
Prevent the nonpoint sources from adversely affecting the river. [Nonpoint sources are sources that do not discharge to the river at well-defined points such as through a pipe.]

Recommendation:
1. Use stream water quality monitoring to determine whether or not these sources are making a significant contribution to the amount of pollutants in the river.

2. If nonpoint sources are important, determine which ones require remedial action.

3. Select and carry out appropriate control or remedial actions.

MAINTAIN CONTROLS ON MUNICIPAL AND INDUSTRIAL WASTEWATER FACILITIES

Objective:
Insure that municipal and industrial point sources do not significantly contribute to impairment of the fishery or aquatic life. [Point sources are sources that discharge to the river at well-defined points, such as through a pipe.]

Recommendation:

1. Renew permits, as they expire, incorporating current technology and water quality based limits.

2. Carry out monitoring of industrial and municipal discharges and compliance or enforcement actions as needed.

IMPROVE COMBINED SEWER OVERFLOW SYSTEMS

Objective:
Insure that combined sewer overflows do not significantly contribute to impairment of the fishery or aquatic life. [Combined sewer overflows are used to relieve the flow to sewage treatment plants during storms when surface runoff would cause the flow in the sewers to exceed the capacity of the system.]

Recommendation:

1. Carry out system modeling to determine where improvements can be made to increase flow within the system and minimize overflow.

2. Design and carry out improvements as necessary.

REMEDIATE OTHER POINT SOURCES AS NECESSARY

Objective:
Insure that other point sources do not significantly contribute to impairment of the fishery or aquatic life.

Recommendation:

1. If stream water quality shows that other point sources are likely to be a problem, then identify these sources.

2. Design and carry out remedial work as required.

RESTORE FISH AND WILDLIFE HABITAT

Objective:
Improve fish and wildlife habitat in and along the river.

Recommendation:

1. Carry out an assessment of habitat conditions and the potential for improvement in the Area of Concern.

2. Develop a habitat improvement plan.

3. Acquire the necessary land.

4. Design and carry out specific habitat improvement projects.

COMMITMENTS AND FUTURE ACTIONS

The Department of Environmental Conservation has committed to a number of initial actions in this plan where funding is available. As further funding becomes available, further commitments can be made. DEC has made commitments for specific actions to begin the remediation strategy:

- Develop requirements for improvement of a sediment model - March, 1990
- Establish a flow-activated sampling station - March, 1990
- Carry out comprehensive dissolved oxygen measurements - March, 1990
- Complete all Phase 1 hazardous waste site investigations - March, 1990
- Complete nine Phase 2 hazardous waste site investigations - March, 1990
- Complete two design feasibility studies at hazardous waste sites - March, 1990
- Continue discharge permit monitoring and reissue permits at five-year intervals for industrial and municipal dischargers
- Develop a plan to assess habitat conditions and to determine the potential for habitat improvement - March, 1990

A continuing process, based on annual status reports and workplans, has been established for reporting on remedial progress, for making commitments as funding becomes available, and for revising the remedial action plan as new information develops.

After the Department has received public comment on this draft, a final remedial action plan will be submitted to the International Joint Commission by the New York State Department of Environmental Conservation.

BUFFALO RIVER CITIZENS' COMMITTEE SPECIAL CONTRIBUTIONS

The Buffalo River Citizens' Committee has prepared a special section of the RAP that presents their legislative and budgetary recommendations. The report also includes a chapter on land use along the river, with recommendations related to future development, prepared by the Buffalo River Citizens' Committee.

CHAPTER 1
INTRODUCTION

The International Joint Commission has designated the Buffalo River as an Area of Concern. This designation indicates that the area exhibits environmental degradation, and that some beneficial uses of the water or biota are impaired.

Under the Amendments to the U.S.-Canada Great Lakes Water Quality Agreement remedial action plans (RAPs) are to be developed by the States and Province of Ontario for the Areas of Concern under their jurisdiction. These plans are to define the environmental problems in the Area of Concern, identify remedial measures needed to restore beneficial uses with a time schedule and the responsible agency, and describe a monitoring process needed to track remediation. The RAP is to be submitted to the International Joint Commission in three stages:

i) when the problem has been defined;
ii) when remedial measures are selected; and
iii) when monitoring indicates beneficial uses have been restored.

The New York State Department of Environmental Conservation (DEC) is the lead agency for the Buffalo River Remedial Action Plan. DEC's Division of Water was responsible for developing the RAP for submission by Commissioner Thomas C. Jorling to the IJC. The Division of Water, while holding the major responsibility for completion of the RAP, worked closely with other DEC Divisions to ensure an ecosystem perspective that was desired in developing the RAP.

The RAP development was also a coordinated effort between community leaders and DEC. Many interested parties were represented through the Buffalo River Citizen's Committee comprised of 21 environmental, sportsmen, small business, university, community, and local government representatives. The Citizens' Committee's activities were focused around three subcommittees: the Database and Remedial Action Subcommittee; the Land Use and Long-Term Goals Subcommittee; and the Public Outreach Subcommittee. Interested parties not represented on the Citizens' Committee were involved through announcements and newsletters, public meetings held in various communities near the Area of Concern, open monthly Citizens' Committee meetings, and through participating directly in subcommittee activities.

Subcommittee chairpersons and key DEC staff formed a ten-member Steering Committee that directed the development of the Buffalo River RAP. The Steering Committee established the goal of the RAP, developed the project workplan, outlined responsibility for key tasks, and reviewed working drafts and data summaries.

The Buffalo River RAP has been developed so that it will be consistent with and supplement other planning efforts in the area. The Erie County Waterfront Horizon Commission Master Plan is proposed to be developed. As yet, a specific master plan for the future of the Buffalo River Area of Concern does not exist. However, there is little likelihood the river will return to heavy industry use or the port will again become a major cargo hub. More likely is the increased use of the river for recreation, light industry, and housing. The goals of the Buffalo River RAP and the recommendations contained therein are consistent with these expected use changes.

The RAP satisfies sections 4(a)(i) and (a)(ii) of the Great Lakes Water Quality Agreement, Annex 2, and is the first submission for the Buffalo River RAP under that Agreement. It also includes the other sections required by Annex 2, but some of these are incomplete at this time. For example, there is no evaluation of alternative remedial measures [4(a)(iv)] related to sediments and no selection of remedial measures with a schedule for implementation [4(a)(v)] related to the contaminated sediment problem. Instead, a general strategy is outlined for deciding on the appropriate remedial measures; and commitments are made to proceed with the first steps of that strategy. As progress is made to the point where specific remedial plans can be adopted, the RAP will be revised and submitted as prescribed in Annex 2.

DEC, as the lead agency, intends to use this RAP as a management document to guide and coordinate remedial actions on the Buffalo River by various concerned agencies for an improved federal, state, and local partnership in addressing the goals of the plan. Specific year-by-year commitments will be made as funding becomes available, and these commitments will be documented in reports to be issued annually.

Other interested parties can use this RAP, with the annual reports, to track progress on remedial activity in the Buffalo River. Funding agencies can use the RAP to determine where resources can best be applied to restore the beneficial uses of the river.

CHAPTER 2
SETTING

Introduction

The setting for the Buffalo River Remedial Action Plan is described in this Chapter. The two major components are the Buffalo River Area of Concern (AOC) (the impact area) and the Buffalo River Watershed (the source area). Each area is described relative to location, character, current water use, hydrology and water quality.

Area of Concern (AOC)

General Description

The Buffalo River Area of Concern is located in the City of Buffalo, Erie County, in western New York State (Figure 2.1). The river flows from the east and discharges into Lake Erie near the head of the Niagara River.

The Buffalo River Area of Concern extends from the mouth of the Buffalo River to the farthest point upstream at which the backwater condition exists during Lake Erie's highest monthly average lake level (Figure 2.2).

The Area of Concern is characterized by heavy industrial development in the midst of a large municipality. Past and present industrial users include grain milling firms such as General Mills and Pillsbury; chemical companies such as Buffalo Color (formerly Allied Chemical); PVS Chemical (formerly Allied Chemical); coke and steel making operations conducted by Donner-Hanna Coke and Republic Steel, respectively; an oil refinery owned by the Mobil Oil Company; and a variety of smaller firms. Today

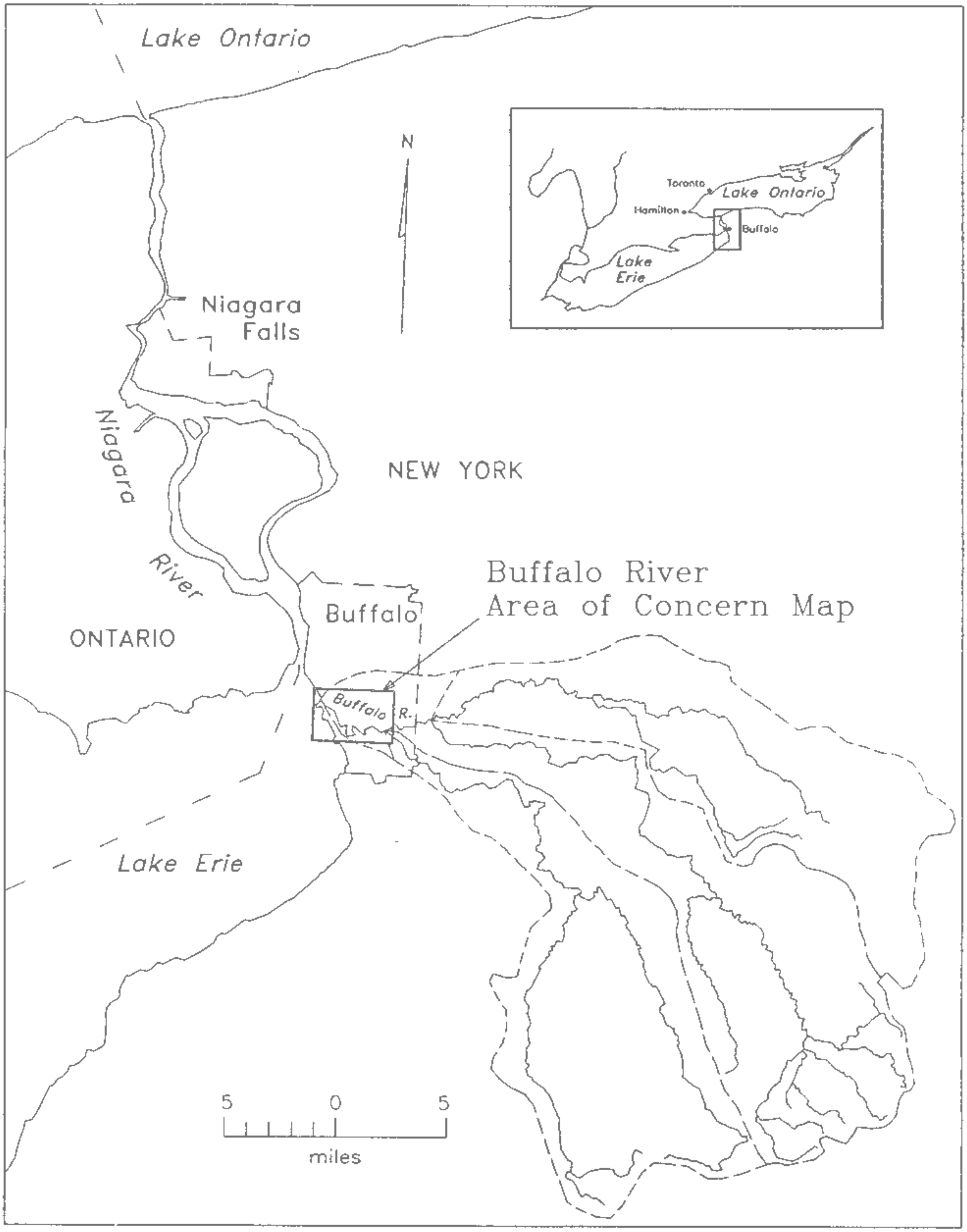


Figure 2.1 Buffalo River Area of Concern Location Map

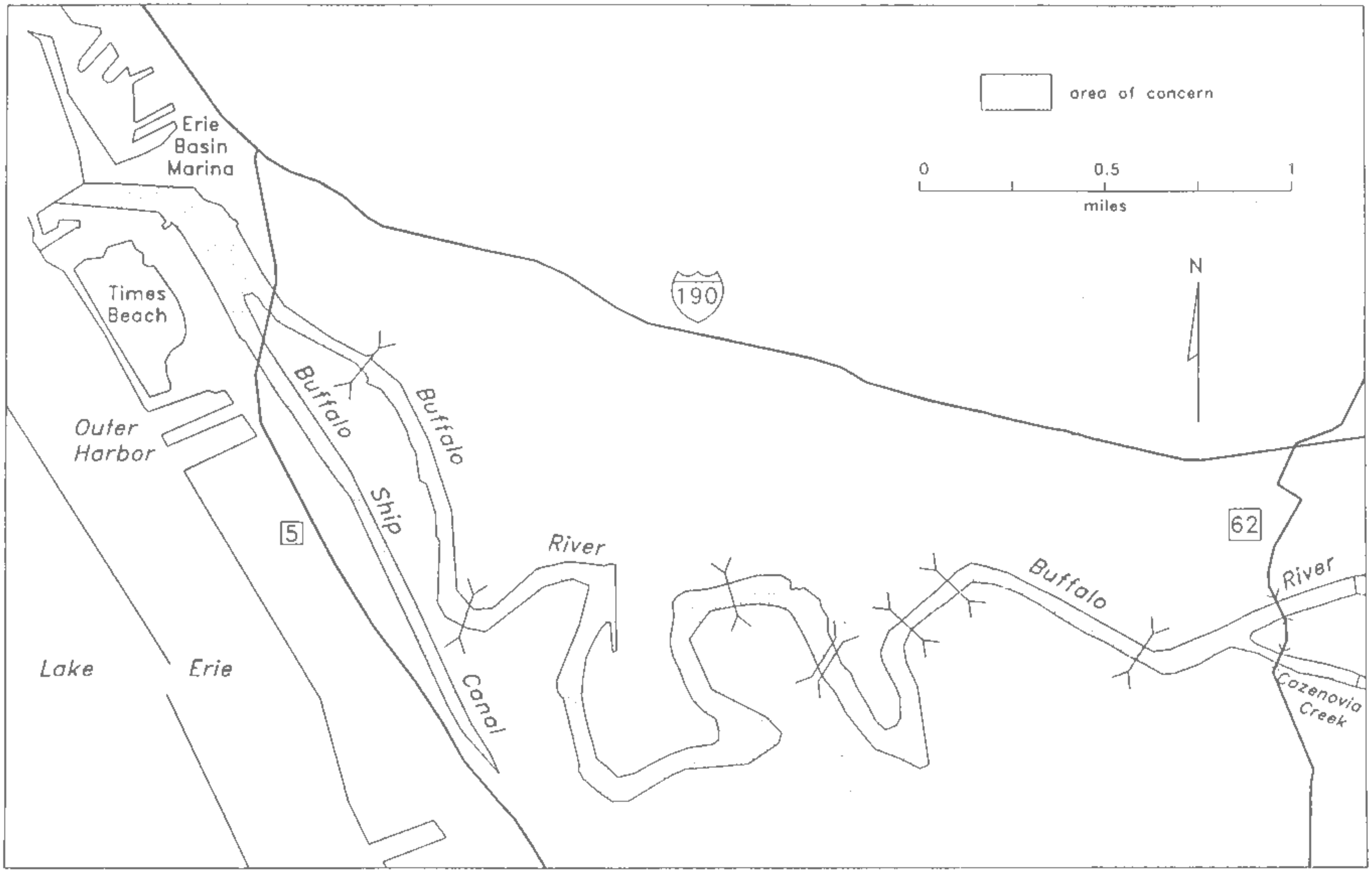


Figure 2.2 Buffalo River Area of Concern

much of this area's economic past can be seen in various stages of abandonment along the Buffalo River's banks.

Current Uses

Industrial development has been and continues to be an important use of the study area. Figure 2.3 names and locates the major industries in the Buffalo River Area of Concern.

The Buffalo River Improvement Corporation (BRIC) was formed in the late 1960's to supply water from the Buffalo Harbor on Lake Erie (about 2.0 miles south of the Buffalo River mouth) to five major industries along the Buffalo River for process and cooling purposes. The BRIC system was designed to supply 120 million gallons per day for this industrial use with the subsequent discharge to augment low flows in the Buffalo River. Due to industrial plant closures and process shutdowns, current pumpage and discharge is about 18 million gallons per day.

The City of Buffalo is served by a combined sewer system which periodically discharges into the Area of Concern. The system was designed to collect and transport both the dry-weather sanitary sewage and most wet-weather storm flow in the Buffalo area. Combined sewer overflow discharges which occur with each major storm event have had an adverse effect on water quality in the Area of Concern.

The Area of Concern is also used as a navigation channel, maintained by the U.S. Army Corps of Engineers, to facilitate lake vessel access to the firms along the river. In 1986 commercial lake freighters made approximately forty trips up the Buffalo River and the Buffalo Ship Canal. (Personal communication Joseph Tocke, NYSDOT). Barges also use the waterway.

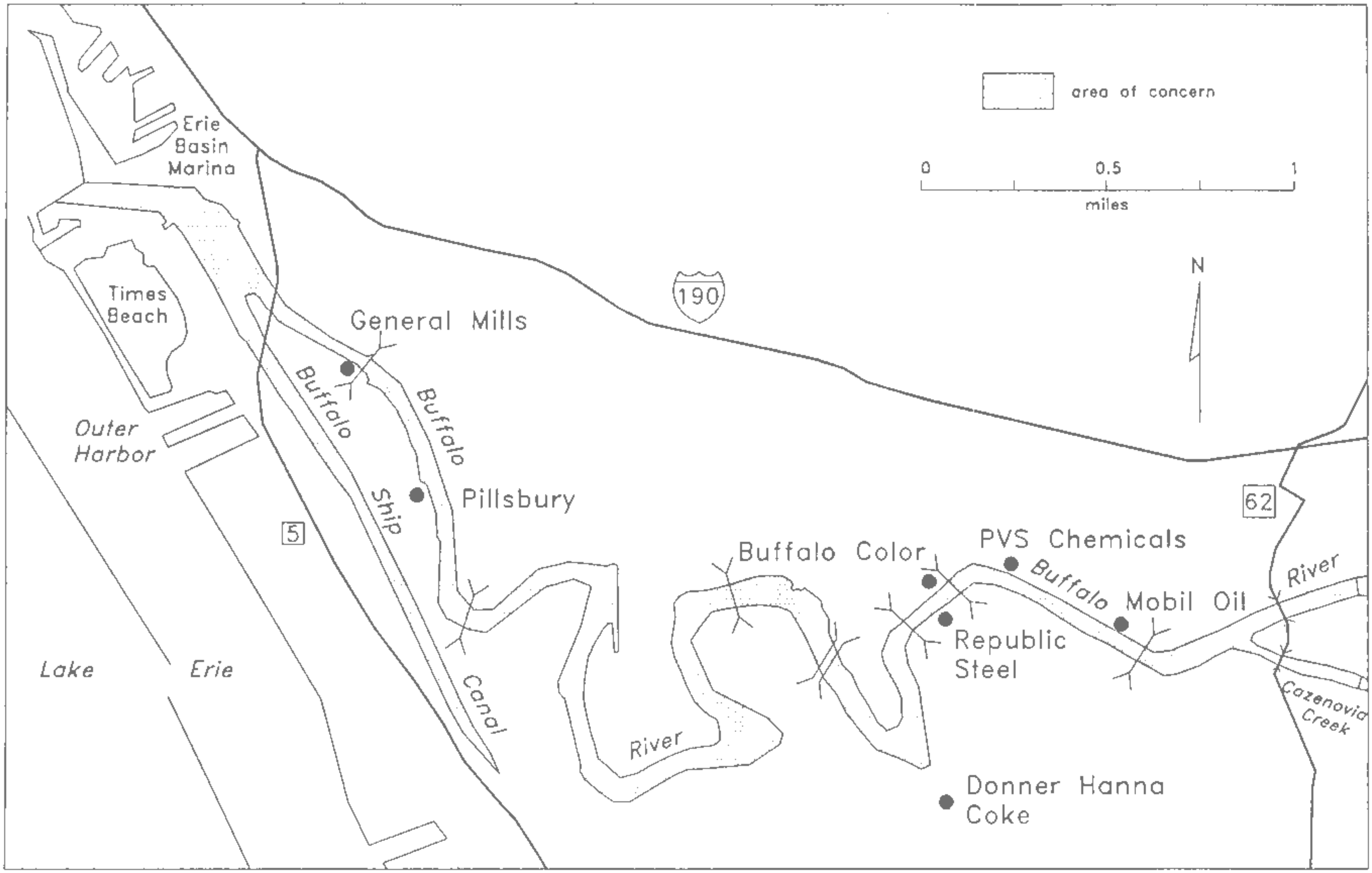


Figure 2.3 Location of Major Industries Along the Buffalo River

Although a few people fish in the AOC, a State Health Department consumption advisory may discourage others from using the AOC as a fishing spot. In addition, fishing use has been restrained due to limited land access points, the river's pollution history and the availability of alternative fishing sites.

Small powerboats travel in the AOC for recreational boating purposes, primarily near the mouth of the river. Some limited unsupervised swimming has also been observed in the river.

Hydrology

In the Area of Concern, the Buffalo River is a navigable channel maintained by the U.S. Army Corps of Engineers at a depth of 22 feet below low lake level datum. The gradient of the river is extremely small, less than one foot per mile.

The Buffalo River is fed by three tributaries: Cazenovia Creek, Buffalo Creek, and Cayuga Creek. The variable flow of the three upstream tributaries is augmented by water pumped by the Buffalo River Improvement Corporation from Lake Erie. This discharge is an addition to the river flow (as opposed to users which withdraw water from and discharge to the waterway).

The lower Buffalo River, because of dredging, is a low velocity reach and is affected by its interaction with Lake Erie. For high flows the waterway has a "riverine" (one directional flow) character. For mean and low flows, the river is influenced by lake level variations associated with the passage of storms through Lake Erie and seasonal thermal differences between lake water and river water. This Lake Erie influence gives the river an "estuarine" character.

During the spring and summer when the river is warm relative to the lake, its less dense waters will generally flow over the cooler and denser lake water. During the fall and winter, the river will be cooler than the lake and will usually flow under the lake water. The water bodies do not remain separate but mix at varying rates.

Sediment inflow trap efficiency studies of the river indicate the river traps all of the sand particles at all discharges below 20,000 cfs. A high percentage of the clay and silt particles which would pass through the river during storm events are retained during periods of normal flow. The wider portions of the river serve as the most efficient trap areas and collect sediments under high flow conditions while much of the remainder of the river system undergoes degradation because of scouring with resultant downstream discharge (Rumer and Meredith, 1987).

Water Quality

The Buffalo River has been subject to pollution problems since the rise of the city in the early nineteenth century. Today, water quality problems remain, but abatement efforts and output reductions of industries have improved the condition of the river.

The DEC has designated the Buffalo River as a Class D waterway, designated for the protection of fishing and fish survival. The DEC system of stream classification is based on the best usage concept developed to protect the best use of the water resource.

Stream classifications are subject to review every three years or are revised on an interim basis upon application or where particular circumstances warrant.
The river classification is currently under review. Public hearings on the reclassification of the Buffalo River and

other tributaries of the Lake Erie-Niagara River basin are scheduled for 1989.

Area Potentially Contributing to Use Impairments

General Description

The watershed of the Buffalo River is roughly triangular in shape as the basin map (Figure 2.4) shows, and has a drainage area of about 446 square miles. There are three major streams in the watershed: Cayuga Creek, Buffalo Creek and Cazenovia Creek.

Cayuga Creek is the northernmost of the three major streams in the Buffalo River Basin. It is 40 miles long and drains 128 square miles of Erie, Genesee and Wyoming Counties. The lower reaches of Cayuga Creek pass through the residential communities of Lancaster and Depew. The upland areas are primarily farmland and wooded areas.

Buffalo Creek drains an area of 150 square miles and joins Cayuga Creek eight miles above Lake Erie to form the Buffalo River. It is 43 miles long from its source near Java Center in Wyoming County to its confluence with Cayuga Creek. The land adjacent to Buffalo Creek is primarily farmland and woods. Buffalo Creek passes through several small communities.

Cazenovia Creek joins the Buffalo River about six miles above Lake Erie. The total watershed area is 138 square miles. Cazenovia Creek is similarly typified by agricultural and wooded sections of land, with several small residential communities and scattered park and recreational areas.

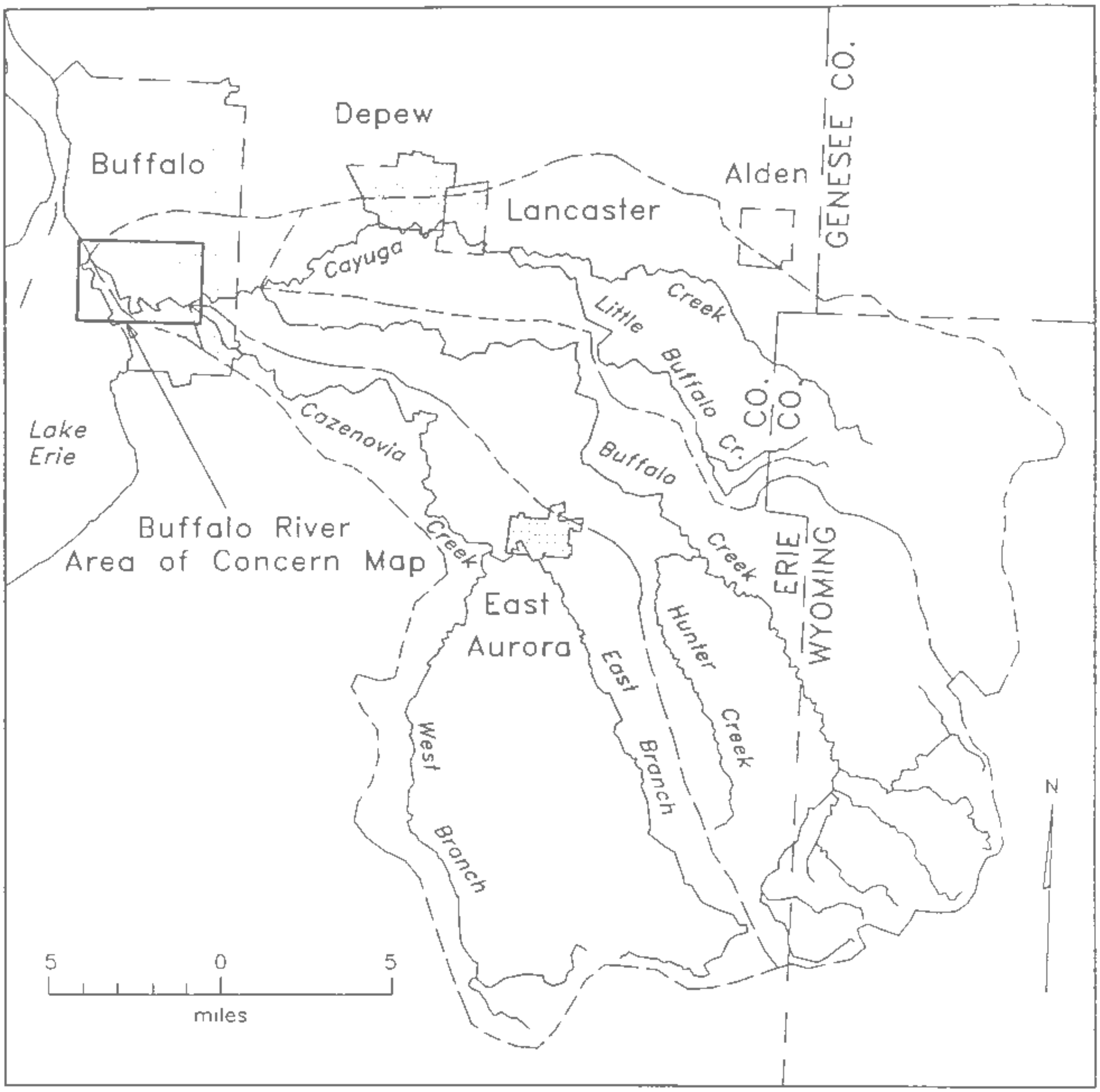


Figure 2.4 Buffalo River Watershed

Current Uses

Cayuga, Buffalo, and Cazenovia Creeks receive discharges from industries, municipal treatment plants, and sewer system overflows. Cayuga Creek receives discharges from one industry and one municipality. The lower one mile reach of Cazenovia Creek receives combined sewer overflow (CSO) discharges from combined relief sewers. Upstream of this lower segment, three municipalities and three industrial facilities discharge to the creek. Buffalo Creek receives three municipal and one industrial facility discharge. The discharges noted above are described in Chapter 5.

The Buffalo River drainage basin provides a wide variety of fish habitat conditions. Basin conditions range from brook trout habitat in some upper stream reaches to warm water species habitat in the lower urban areas. Trout, salmon, black bass, and northern pike are among the many species found within the watershed. The DEC stocks the Little Buffalo Creek (on Cayuga Creek system), the main Buffalo Creek, and the East Branch Cazenovia Creek with trout. Como Park Lake (Cayuga Creek) is stocked with panfish. In addition, the Buffalo Harbor is stocked with trout (Figure 2.5).

Hydrology

Upstream of the mouth of the Buffalo River, Cazenovia Creek discharges into the Buffalo River at Mile Point 5.8. Further upstream at Mile Point 8.1, the head of the Buffalo River is defined by the U.S. Geological Survey as the confluence of Buffalo Creek and Cayuga Creek.

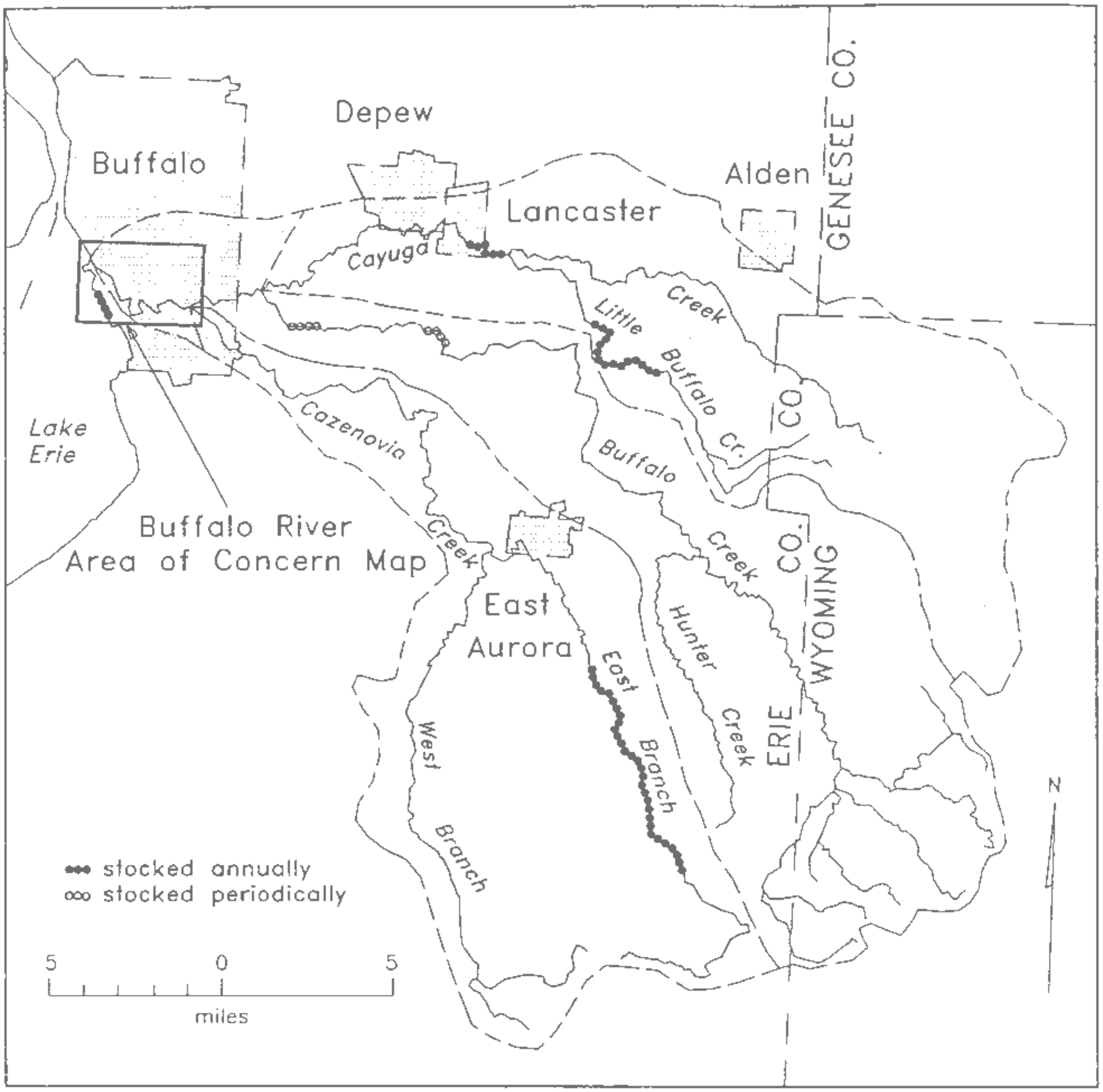


Figure 2.5 Location of DEC Fish Stocking Sites in the Buffalo River Watershed

The three major tributaries are generally fast flowing streams with many rapids and low waterfalls. Table 2.1 lists flow information for the tributaries.

Water Quality

Water quality monitoring stations on the upper Cayuga, Buffalo and Cazenovia Creeks (Figure 2.6) were sampled by DEC in 1987. Analytical mean values for the three tributaries as well as the Buffalo River values, which are presented in Table 2.2, indicate high quality water at these monitoring stations.

As a measure of the water quality, the analytical mean values for the tributary streams can be compared to water quality standards, as shown in Table 2.2. The comparison with Class A standards (best use drinking water), indicates that the three tributaries meet the established standards for Class A waters for all parameters analyzed, except iron. The exceedance of the iron standard at the three upstream stations suggests the presence of naturally occurring iron in the watershed.

In addition to conventional parameters and metals, volatile organic compounds were analyzed in the 1987 DEC water quality monitoring program. Each of the four stations (three tributaries and the Buffalo River) was sampled seven times. Analyses were completed for 43 volatile organic compounds (Table 2.3). Of the 1204 analyses performed, one detectable value (trichloroethene) was observed. Detection limits of one part per billion were achieved. The virtual absence of volatile organics at these concentrations is further evidence of the high quality of the water in these streams.

TABLE 2.1

STREAMFLOW
BUFFALO RIVER AND TRIBUTARIES
(mgd) 1/

Stream	Peak Flow 2/	Avg. Annual Flow	Avg. Summer Flow	Min. 7-Day Flow 3/
Buffalo Creek	7300	130	20	2.7
Cazenovia Creek	8720	150	21	3.0
Cayuga Creek	6100	85	8	0.3
Buffalo River	4/	365	49	6.0

1/ Million gallons per day

2/ Instantaneous

3/ Minimum average 7 consecutive day flow with a return frequency of once in ten years

4/ Not additive, peak flows occurred at different times

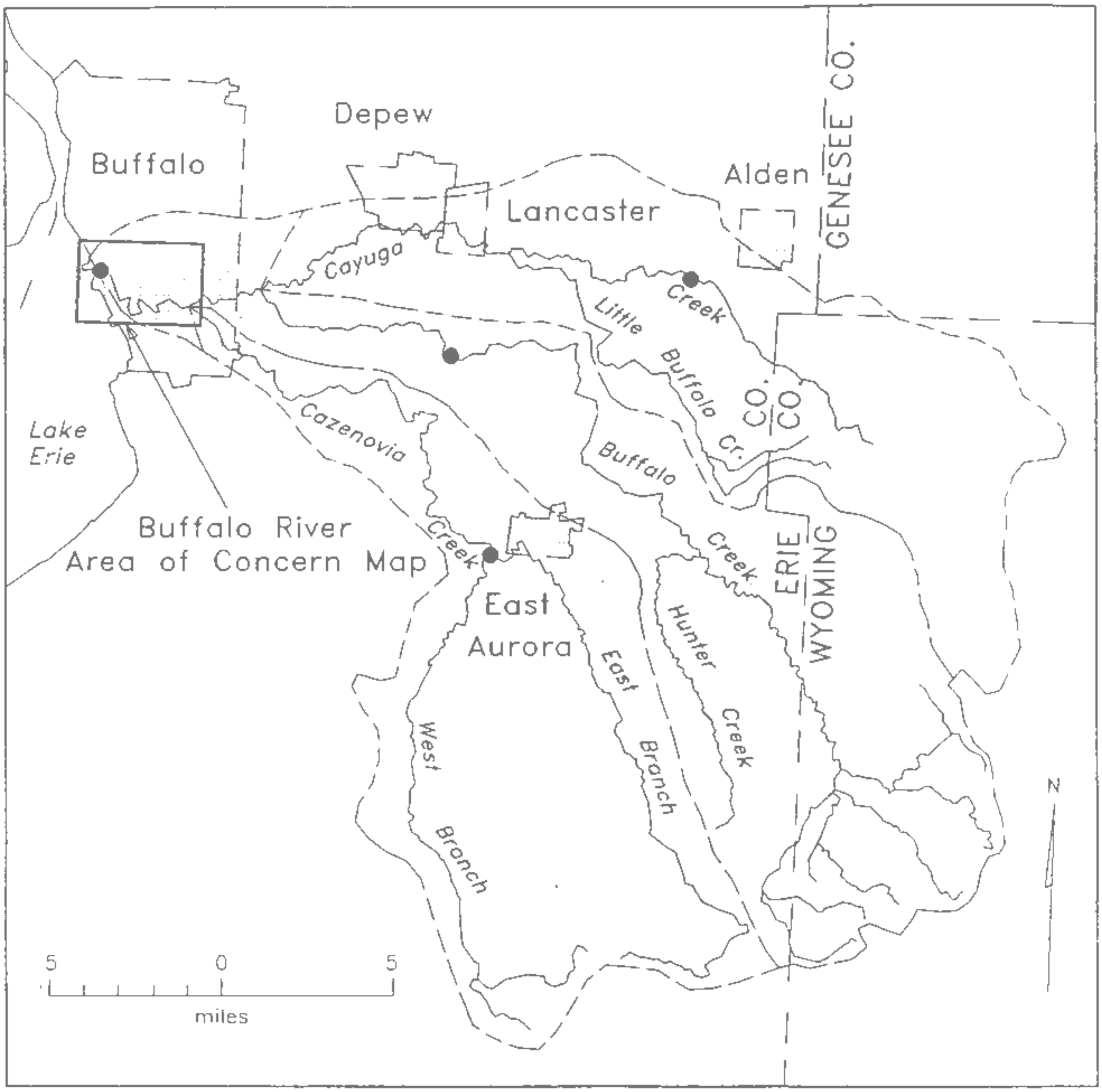


Figure 2.6 Location of DEC 1987 Water Quality Monitoring Stations in the Buffalo River Watershed

TABLE 2.2

BUFFALO RIVER WATERSHED
DEC WATER QUALITY MONITORING DATA [1]
1987

			Cayuga Creek at Alden		Buffalo Creek at Blossom		East Branch Cazenovia Creek at E.Aurora		Buffalo River at Ohio Street		Water Quality Standards		
Parameter	Units	Detection Limits	Mean [2]	Detections/ Observations	Mean [2]	Detections/ Observations	Mean [2]	Detections/ Observations	Mean [2]	Detections/ Observations	Class D	Class C/B	Class A
Cadmium	ug/l	1	nd	0/7	0.1	1/7	nd	0/4	nd	0/7	6	2	2
Copper	ug/l	10	4	3/7	7	3/7	5	2/4	9	6/7	25	16	16
Lead	ug/l	5	2	1/7	nd	0/7	3	1/3	7	3/6	131	5	5
Mercury	ug/l	0.1	0.05	2/6	0.030	1/6	nd	0/4	0.03	2/7	0.2	0.2	0.2
Nickel	ug/l	1	0.4	1/7	1	3/7	nd	0/3	2	3/7	2433	126	126
Zinc	ug/l	10	10	3/7	11	5/7	10	3/4	16	4/7	435	25	25
Iron	ug/l		371	7/7	893	7/7	490	4/4	1410	7/7	300	300	300
Manganese	ug/l	10	16	5/7	34	6/7	60	4/4	86	7/7	ns	ns	ns
Nitrogen Ammonia as N	mg/l		0.018	7/8	0.036	8/8	0.29	4/4	0.22	8/8	7.9	2	2
Nitrogen Kjeldahl as N	mg/l		0.24	8/8	0.28	8/8	0.48	4/4	0.61	8/8	ns	ns	ns
Nitrogen Nitrite as N	mg/l		4.6	4/7	6.9	5/7	24.8	4/4	22.5	8/8	ns	100	100
Nitrogen Nitrate + Nitrite as N	mg/l		0.69	7/8	0.82	8/8	0.59	4/4	0.48	8/8	ns	ns	ns
Phosphate Reactive as P	mg/l		0.002	7/8	0.001	4/8	0.055	4/4	0.01	8/8	ns	ns	ns
Phosphate Total as P	mg/l		0.026	8/8	0.057	8/8	0.114	4/4	0.105	8/8	ns	ns	ns
Solids, Total	mg/l		201	8/8	248	8/8	221	4/4	276	8/8	ns	ns	ns
Solids, Total Volatile	mg/l		65	8/8	76	8/8	54	4/4	82	8/8	ns	ns	ns
Solids, Total Fixed	mg/l		136	8/8	173	8/8	167	4/4	194	8/8	ns	ns	ns
Solids, Total Dissolved	mg/l		179	8/8	217	8/8	196	4/4	217	8/8	500	500	500
Conductivity	umho/cm		294	8/8	339	8/8	356	4/4	370	8/8	ns	ns	ns
Turbidity	NTU		5.6	8/8	15.8	8/8	7	4/4	31.9	8/8	ns	ns	ns
Dissolved Oxygen	mg/l		10.9	3/3	10.6	3/3	10.7	2/2	6.0	7/7	3	4	4
Temperature	deg. C		13.9	7/7	17.4	7/7	14.6	4/4	14.6	8/8	32	32	32
pH	S.U.		8.26	7/7	8.41	7/7	8.36	4/4	7.79	8/8	6.5-8.5	6.5-8.5	6.5-8.5

[1] Volatile organic parameters were analyzed with 1 detection out of 1204 analyses at detection limit of 1.0 ug/l
[2] Means calculated with not detected values equal to zero
nd - Not detected
ns - No standard or criteria

TABLE 2.3

VOLATILE ORGANIC COMPOUNDS ANALYZED
IN THE 1987 DEC WATER QUALITY MONITORING 1/

BIS(2-CHLOROETHYL)ETHER
BIS(2-CHLOROISOPROPYL)ETHER
BROMOBENZENE
BROMODICHLOROMETHANE
BROMOFORM
BROMOMETHANE
CARBON TETRACHLORIDE
CHLOROBENZENE
1-CHLOROCYCLOHEXENE-1
CHLOROETHANE
2-CHLOROETHYLVINYL ETHER
CHLOROFORM
CHLOROMETHANE
ORTHO-CHLOROTOLUENE
1,2-DIBROMO-3-CHLOROPROPANE
DIBROMOCHLOROMETHANE
1,2-DIBROMOETHANE
DIBROMO METHANE
1,2-DICHLOROBENZENE
1,3-DICHLOROBENZENE
1,4-DICHLOROBENZENE
DICHLORODIFLUOROMETHANE
1,1-DICHLOROETHANE
1,2-DICHLOROETHANE
1,1-DICHLOROETHENE
CIS-1,2-DICHLOROETHENE
TRANS-1,2-DICHLOROETHENE
1,2-DICHLOROPROPANE
1,3-DICHLOROPROPANE
2,3-DICHLOROPROPENE
CIS-1,3-DICHLOROPROPENE
TRANS-1,3-DICHLOROPROPENE
METHYLENE CHLORIDE
PENTACHLOROETHANE
1,1,1,2-TETRACHLOROETHANE
1,1,2,2-TETRACHLOROETHANE
TETRACHLOROETHENE
1,1,1-TRICHLOROETHANE
TRICHLOROETHENE
1,1,2-TRICHLOROETHANE
TRICHLOROFLUOROMETHANE
1,2,3-TRICHLOROPROPANE
VINYL CHLORIDE

1/ EPA method 502.1 - Volatile Halogenated Indicators

CHAPTER 3
THE GOALS

Introduction

There are two goals for the Buffalo River RAP. The first is based on restoring the impaired classified best uses of the river. This is termed a short-term goal because, with availability of sufficient funds, it could be accomplished in a 10 to 20 year time period. The second goal is based on the elimination of all pollutant sources. This is termed a long-term goal because although the attainment of zero (complete elimination) is probably physically impossible, progress toward zero is possible. A number of programs are in place that are moving in that direction.

The two goals form the foundation of this report. How the rest of the report is constructed will be outlined in this chapter after the goals are presented.

The Short-Term and Long-Term RAP Goals

Water bodies in New York State are required by law to be classified for their best uses. The classification is based on such factors as the character of bordering lands, stream flow, water quality, present and past uses, and future uses that may be made of the water. The Department of Environmental Conservation (DEC) assigns to each fresh surface water one of the following classifications, reflecting actual or intended best use of that water. Each class includes all uses for the classes below it.

Class	Best Water Use
AA, A	Drinking water
B	Primary contact recreation
C	Fishing and fish propagation
D	Fishing

The Great Lakes Water Quality Agreement has specific objectives which are numerical values for water quality. These objectives apply specifically to boundary waters and are considered in the adoption of New York State standards for such waters. The Buffalo River is situated entirely within New York State.

The Buffalo River is currently classified for fishing (Class D) under the New York State stream classification system. This classification is the basis for restoration of impaired best uses of the river. Proposals are under consideration by DEC to upgrade the Buffalo River stream classification. The Buffalo River Citizens' Committee (BRCC) has petitioned for a B classification and hopes eventually for an A classification.

Stream classifications are subject to review every three years or are revised on an interim basis upon application or where particular circumstances warrant. These revisions are public processes where DEC seeks the views of all interested parties in order to arrive at a decision.

Each designated classification has a set of standards defining the type and quantity of substances the water can contain and still be used as intended. The standards are specific quantities or ranges of such factors as pH (acidity or alkalinity), turbidity, color, temperature, presence of taste and odor producing substances, bacteria, dissolved oxygen, and concentrations of 95 toxic substances, including metals, organic compounds, and radioactive materials.

The standards describe the chemical, physical and biological characteristics necessary to achieve the designated usages.

> The short-term goal of the Buffalo River Remedial Action Plan is to restore and maintain the chemical, physical, and biological integrity of the Buffalo River ecosystem in accordance with the Great Lakes Water Quality Agreement.

Inherent in the implementation of this plan is the restoration of water quality which provides for propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water, consistent with state law and state rules and regulations as they continue to evolve. The BRCC believes some changes in law are needed now, and their proposals for change are presented in Chapter 7.

The 14 impairment indicators listed in the Great Lakes Water Quality Agreement, Annex 2, are used to determine whether or not this goal is being met. These impairment indicators (see Chapter 4) are in many cases synonymous with New York's best uses. However, in some cases (e.g., restrictions on dredging activities) they go beyond what New York considers a best use and in other cases (e.g., degradation of benthos), they should be considered as indicators of a best use impairment and not a best use itself. In any case, all the impairments or impairment indicators in Annex 2 are addressed in determining whether or not an impairment requiring remediation exists.

In addition to addressing impairment of best use, the Remedial Action Plan must be consistent with the purpose and objectives of the Great Lakes Water Quality Agreement. The consistency of the RAP with "virtual elimination of persistent toxic substances" relates to Article II of the Great Lakes Water Quality Agreement which states "...it is the policy of the Parties that:

a) The discharge of toxics substances in toxic amounts be prohibited and the discharge of persistent toxic substances be virtually eliminated;"

This is further reinforced in Annex 12, paragraph 2(a)(ii) which states "The philosophy adopted for control of inputs of persistent toxic substances shall be zero discharge".

While the Agreement contains no further definition of "virtually eliminated", it is a policy that requires mechanisms to be in place by the Parties that will, over time, reduce the total loading of persistent toxic substances discharged to the Great Lakes. In the 1987 revisions to the Agreement, the phrase "pending virtual elimination of persistent toxic substances in the Great Lakes ecosystem,..."in Annex II, 2b, indicates concern not only for point sources into the system, but also indirect sources to the Great Lakes and documented hot-spots where high concentrations exist.

A mechanism for achieving virtual elimination from point source discharges in New York State is through technology-based permit limits established under the Clean Water Act requirements for Best Available Technology Economically Achievable (BAT), and Best Professional Judgment (BPJ). BAT limits are to be promulgated by EPA, while BPJ limits are to be developed by the states for substances where the EPA limits have not been promulgated. These limits are independent of stream classification and water quality standards, and are determined from nationally based treatment technology and economic considerations. When discharge permits are written by New York State, the discharge limits are always as strict as the technology-based limit (BAT or BPJ) and may be stricter if a water quality standard exists that can only be met in the receiving waters with additional process modification. As technology improves and becomes more economically available, the loading of pollutants from point sources should decrease. Indeed, there are some BAT limits now that are set at zero discharge. Not only has New York incorporated federal BAT limits, where available, into discharge permits, it has also aggressively developed its own BPJ limits where federal BAT limits are not available.

In addition to technology-based permit limits, there are a number of other activities, independent of stream classification, that are decreasing and will continue to decrease the loadings of persistent toxic substances. Examples of some are:

- remedial action at hazardous waste sites;
- use of best management practices to control nonpoint source runoff;
- reduction in use of persistent toxic substances in manufacturing.

If and when technology and economic feasibility do not allow for the further reduction of toxic loadings, further plans and controls may be required to meet the general principles of the Agreement and the goal of the Clean Water Act.

The long-term goal is based on a recognition of the ultimate desire for the elimination of all pollutant discharges to all waterbodies. This goal applies to the Buffalo River as well as all other waterbodies of the state.

<u>The long-term goal of the Buffalo River Remedial Action Plan is the elimination of the discharge of pollutants to the Buffalo River. This includes, but goes beyond, the Great Lakes Water Quality Agreement policy of the virtual elimination of discharges of persistent toxic substances.</u>

The immediate intent of this RAP is to address the short-term goal. As remedial action moves us toward the short-term goal, so will we also move toward the long-term goal. In addition, the various statewide program activities driving us toward pollution elimination that have been discussed will be in operation. Since these are statewide activities, the Buffalo River RAP will include them in the plan by reference only. The RAP will focus on the immediate objective-attainment of the short-term goal, primarily through actions specific to the Buffalo River.

Remedial Action Plan Structure

The structure associated with the development of the Buffalo River RAP is outlined in Table 3.1. It starts with the identification of the plan goal, and then proceeds through:

- an assessment of impairments that prevent attainment of the goal;
- a determination of the pollutants or disturbances causing impairments;
- a determination of the sources of the pollutants or disturbances;
- the development of a remedial strategy for the sources or origins so that beneficial uses are restored and goals are attained;
- the decision on commitments that can be made now to certain parts of the remedial strategy;

TABLE 3.1

STRUCTURE FOR THE DEVELOPMENT OF THE BUFFALO RIVER RAP

<u>Identify Goals</u>

a) short-term (based on classified best uses)

b) long-term (based on pollution elimination)

↓

<u>Assess Impairments</u>
<u>That Prevent Attainment of Short-Term Goal</u>

↓

<u>Identify Pollutants or Disturbances</u>
<u>Causing Impairments</u>

↓

<u>Identify Sources of Pollutants or</u>
<u>Disturbances Causing Impairments</u>

↓

<u>Describe Remedial Strategy</u>

↓

<u>Describe Monitoring Strategy</u>

- the design of a monitoring program to show that the impairments have been corrected and how progress is being made to attain the goal.

Identification of Goals

Two goals are identified. The first (or short-term) is related to the restoration of impaired best uses, and its attainment is measurable in terms of criteria that can be developed for each impaired use. The second goal (long-term) is related to the elimination of pollutant discharges, which is the goal of the federal Clean Water Act and a policy of the parties to the Great Lakes Water Quality Agreement. The attainment of this goal (no pollutant discharge or virtually no discharge) cannot be measured, but certainly progress toward attainment can be measured.

Assessment of Impairments

Once goals have been specified, then the actual impairments that prevent these goals from being realized can be identified. The short-term goal is addressed through examining environmental information that shows whether or not the Great Lakes Water Quality Agreement indicators suggest a water quality impairment.

Impairments to the long-term goal consist of ongoing sources of pollutants to the river. Even when such discharges of pollutants are not of a magnitude to cause an impairment of best use, by their very existence, they prevent attainment of the long-term goal. As pointed out previously, this plan will focus on developing remedial actions to achieve the short-term goal. Actions to achieve the long-term goal are embodied in statewide programs and are proceeding independently of the RAPs.

In many cases, it is not easy to determine whether or not an impairment exists because of the absence of information on the environmental system, or the subjective nature of some of the impairment indicators. Therefore, instead of always stating definitely that there is or is not an impairment, conclusions may be listed as "likely", "not likely", or "no evidence".

Pollutants or Conditions Causing Impairment

Each of the indicators of impairment for the desired uses can be examined to determine the direct cause of the impairment, whether it be a specific pollutant such as a chemical substance, or a condition of the Area of Concern such as a lack of suitable habitat.

Again, as with the assessment of impairments, is some cases definite causes cannot be assigned to impairments with a high degree of certainty. In the succeeding chapters, an attempt is made to make the identification of this uncertainty explicit when it occurs.

Sources of Pollutants or Origin of Conditions

The actual points of entry of pollutants or the origin of the conditions must be determined before the remedial actions needed can be designed. These sources (or origins) may include discharge pipes, run-off of stormwater over land, atmospheric deposition, release of pollutants from sediments, or construction activities which have obliterated wildlife habitats. The identification of some sources may be uncertain.

Remedial Strategy

The identified sources and conditions are the basis for the remedial strategy. This strategy must be broad enough to deal with the uncertainties noted above in the assessment of impairments, pollutants/conditions, and sources/origins. Therefore, the strategy will have in it an important element of further investigation, information gathering, and decision making based on new findings and interpretations. As progress is made in carrying out the remedial strategy, details will be filled in as necessary, and alterations in the strategy will probably be needed.

Within the overall strategy, there are some specific remedial activities that can be described now. These specific activities are of two types: 1) those where agencies can make specific commitments to complete with a time schedule; and 2) those where commitments cannot be made because funding or other resources are not available.

The inability to obtain funds to support specific parts of the strategy will be an important indicator that either there is not a real public acceptance of the strategy and the strategy will require revision, or the public does not perceive that the benefits gained by fully restoring the use are worth the cost, and that only partial restoration of the use may be needed.

Monitoring Remedial Actions and Goal Attainment

As the detailed remedial activities are designed, there will be accompanying monitoring components to insure that the remedial actions work as planned, and that the indicators of use impairment show recovery. To the extent feasible, assessments will be made directly of the ecosystem to examine the status of the impairment indicators.

CHAPTER 4
THE PROBLEMS

Introduction

Use impairments and their likely causes in the Buffalo River are identified in this Chapter through examination of the 14 Great Lakes Water Quality impairment indicators. Water quality and bottom sediment data are summarized early in the chapter because of the general applicability of these data in the consideration of impairments. Biota data are presented as they relate to specific impairment indicators.

In assessing environmental conditions and potential impairment of beneficial uses of the Buffalo River, current available data have been used. From the 1970's through 1982, the major direct continuous discharges to the Buffalo River were upgraded with additional treatment, or were terminated or redirected from the river system. For this reason, the data used to assess potential impairments have primarily been collected since 1982. One exception is bottom sediment data, collected in 1981.

Water Quality Data

The DEC collected thirty samples from the Ohio Street Bridge station on the Buffalo River during the period April 1982 through March 1986. One hundred twenty-five inorganic, three physical and two bacteriological analyses were performed from four to thirty times for the samples obtained. A statistical summary of the analytical data is presented in Table A.1, Appendix along with standards and criteria values associated with the New York State stream classification system.

The statistical summary reveals the broad properties of the data set. Presented in the summary are mean, median (50th percentile), lower fourth (generally 25th percentile), and upper fourth (generally 75th percentile) values. The number of outliers in the data set are also identified. Outliers are individual data points which depart from the broad pattern of the data set. They are defined as those values which are more distant than one and one-half times the difference between the fourth points when added to the upper fourth point or subtracted from the lower fourth point. The mean value of the data set is used in the text when referring to water column data.

The mean values (non-detects equal zero) of all the parameters monitored at the Ohio Street Bridge station on the Buffalo River during the 1982-86 period were in compliance with Class D standards and criteria. (Current analytical detection limits exceed many water quality standard and criteria levels. Detection limits are listed in Table A.1).

The exceedance frequency of New York State water quality standards and criteria by the water samples collected by DEC at the Ohio Street Bridge from April 1982 to March 1986 is shown in Table A.2, Appendix. The data indicate that for all of the parameters analyzed, the standards and criteria for the current Class D designation of the Buffalo River were exceeded in only one out of thirty samples for lead and mercury and the allowable pH range was exceeded in only one out of twenty-four samples.

The mean values of all of the parameters, with the exception of lead, are in compliance with Class C/B standards and criteria. The mean value for lead (9.1 ug/l) exceeded the Class C/B standard (5.0 ug/l). In twenty-eight of the thirty samples lead was non-dectectable. The two detectable values were calculated as shown in Table A.1 to be outliers. The outlier values were 260 and 12 ug/l.

The standards and criteria for the Class C/B designations were exceeded in 5 out of 30 samples for zinc, 2 out of 30 samples for chromium and lead and one out of thirty samples for mercury. The pH range was only exceeded in one out of twenty-four samples.

Based on exceedance frequency the analytical data indicates general compliance with the current Class D designation. Compliance with Class C/B standards and criteria is also high.

Bottom Sediment Data

Bottom sediment data were collected by the U.S. Environmental Protection Agency - Region V (EPA) and the U.S. Army Corps of Engineers - Buffalo District (COE) in 1981 and by the New York State Department of Environmental Conservation (DEC) in 1983. A 0.3 mile pilot bottom sediment study area along the Buffalo River was sampled by Erie County under contract with DEC in 1985 (Figure 4.1). Statistical summaries of the data including mean values, median values and contaminant range values are presented in Tables A.3 through A.6, Appendix. Specific sampling locations and chemical concentrations at each location may be identified from agency reports listed under References. Because of the variability of sampling and analytical techniques, median values (which are not affected by outliers) are used in the discussion of sediment data in this report.

The EPA sampled 17 sites along the Buffalo River in 1981 (Table A.3, Appendix). These samples were collected primarily adjacent to outfalls along the river. Two hundred

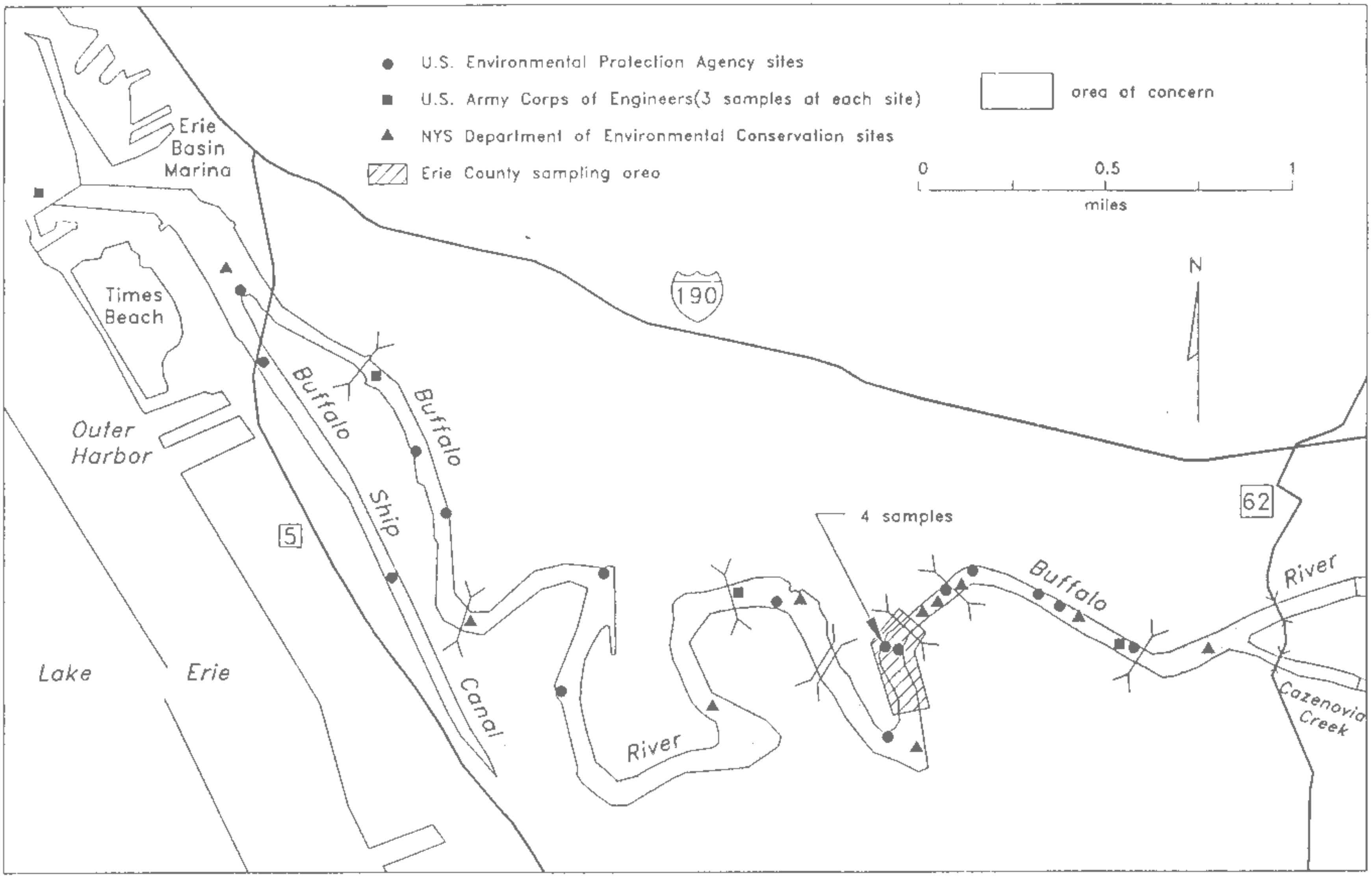


Figure 4.1 Location of Sediment Sampling Sites in the Buffalo River Area of Concern

nineteen organic and thirty inorganic analyses were performed.

The COE sampled four sites three times each along the Buffalo River in 1981 (Table A.4, Appendix). The sampling sites were in areas of stream sediment deposition along the river. Thirty-two organic analyses were performed. Twelve inorganic parameters were also analyzed.

The COE sampling medians for the Buffalo River were compared with the medians of three COE reference samples taken on the Lake Erie side of the Buffalo Harbor breakwall (Table 4.1). Of the 32 organic parameter analyses, 24 were non-detectable in both the Buffalo River and in Lake Erie. For five organic parameters the Buffalo River median concentration was greater and for three organic parameters the Lake Erie median concentration was greater. Of the 12 inorganic parameter analyses, 10 Buffalo River median concentration values were greater. The concentrations of all organic and inorganic analyses with detectable values in both the Buffalo River and Lake Erie were within the same order of magnitude with the exception of phenols (4AAP) for which the Buffalo River value was greater by one order of magnitude.

The DEC sampled 10 sites along the Buffalo River in 1983 (Table A.5, Appendix). Eighteen organic analyses (PAHs) were performed.

The DEC sampling medians for the Buffalo River were compared with the medians of three DEC samples taken along the south shore of Lake Erie (Table 4.2). For all the 18 organic parameters (PAHs) analyzed, the Buffalo River medians were greater than the Lake Erie medians. The sum of the Buffalo River PAH medians was 32 ug/g compared to 1.9 ug/g for Lake Erie. For two parameters the Buffalo River

TABLE 4.1

COMPARISON OF CONTAMINANT CONCENTRATIONS IN BUFFALO RIVER
BOTTOM SEDIMENTS WITH LAKE ERIE BOTTOM SEDIMENTS
USACOE - BUFFALO DISTRICT SAMPLING - 1981
(ug/g)

PARAMETER	BUFFALO RIVER MEDIAN [1]	LAKE ERIE MEDIAN [2]
di-2-ethylhexyl phthalate	0.000	0.000
di-n-butyl phthalate	0.160	0.000
2,4-D isopropyl ester	0.000	0.000
hexachlorobenzene	0.000	0.000
beta-BHC	0.000	0.040
gamma-BHC	0.000	0.000
heptachlor	0.010	0.000
aldrin	0.000	0.000
heptachlor epoxide	0.000	0.000
dieldrin	0.000	0.000
4,4'-DDE	0.000	0.000
endrin	0.000	0.000
4,4'-DDD	0.000	0.000
4,4'-DDT	0.000	0.000
methoxychlor	0.000	0.000
PCB-1242	0.000	0.000
PCB-1248	0.000	0.000
PCB-1254	0.450	0.100
PCB-1260	0.000	0.000
gamma-chlordane	0.000	0.000
DCPA	0.080	0.070
2,4'-DDD	0.000	0.000
2,4'-DDE	0.000	0.000
2,4'-DDT	0.000	0.020
alpha-endosulfan	0.000	0.000
beta-endosulfan	0.000	0.000
isodrin	0.000	0.000
mirex	0.000	0.000
tetradifon	0.000	0.000
trifluralin	0.030	0.110
zytron	0.000	0.000
aluminum	8990.000	4300.000
arsenic	10.900	6.100
cadmium	1.150	0.000
chromium	30.350	19.500
copper	63.850	18.600
iron	27250.000	25700.000

TABLE 4.1 (continued)

PARAMETER	BUFFALO RIVER MEDIAN [1]	LAKE ERIE MEDIAN [2]
lead	121.000	21.900
manganese	483.500	651.500
mercury	0.540	0.110
nickel	36.750	18.700
zinc	390.700	267.100
cyanide	0.331	0.416
phenols (4AAP)	0.381	0.031

FOOTNOTES

[1] 12 Samples
[2] 3 Samples
Mean values and contaminant range values for the Buffalo River are presented in Table A.4, Appendix.

TABLE 4.2

COMPARISON OF CONTAMINANT CONCENTRATIONS IN BUFFALO RIVER BOTTOM SEDIMENTS WITH LAKE ERIE BOTTOM SEDIMENTS
NYSDEC SAMPLING - 1983
(ug/g)

PARAMETER	BUFFALO RIVER MEDIAN [1]	LAKE ERIE MEDIAN [2]
fluorene	0.169	0.039
phenanthrene	1.686	0.310
anthracene	0.579	0.055
fluoranthene	4.034	0.369
pyrene	3.527	0.229
chrysene	0.578	0.055
benzo(b)fluoranthene	1.491	0.081
benzo(k)fluoranthene	0.647	0.052
benzo(a)pyrene	1.163	0.091
indeno(1,2,3-cd)pyrene	1.656	0.062
dibenz(a,h)anthracene	0.278	0.017
benzo(g,h,i)perylene	1.345	0.060
methylphenanthrene	0.583	0.055
methylanthracene	0.400	0.019
benzofluorene	4.038	0.128
benzanthracene	1.139	0.107
benzo(e)pyrene	3.726	0.033
perylene	4.994	0.150

FOOTNOTES

[1] 10 Samples
[2] 3 Samples (near Lake Erie south shore)
Mean values and contaminant range values for the Buffalo River are presented in Table A.5, Appendix

medians were the same order of magnitude, for 15 parameters the Buffalo River medians were greater by one order of magnitude and for one parameter (benzo(e)pyrene) the Buffalo River median was two orders of magnitude greater than the Lake Erie values.

Erie County sampled and analyzed 162 samples from 58 cores taken along a 0.3 mile pilot study area of the Buffalo River between Mile Point (MP) 4.43 and 4.73 (Table A.6, Appendix). Cores were attempted on transects spaced at 100 foot intervals at five locations across each transect. The core locations were at the 10 foot and 18 foot water depth on the stream banks and at the channel center. An attempt was made at each location to obtain a sediment core using a 48 inch vibracore tube. In some cases, a sediment core could not be obtained due to the presence of rock or high density soil and a surficial grab sample was attempted. Six inch samples were taken from each core at the top, middle and bottom. Sixteen grab samples were also obtained at an upstream control area outside of the Area of Concern.

A comparison of the Erie County sampling medians in the Area of Concern with the upstream control area is shown in Table 4.3.

Buffalo River bottom sediment data indicate the presence of contaminants. Contaminant levels are frequently higher in the Buffalo River Area of Concern than in nearby nearshore areas of Lake Erie and upstream Buffalo River control areas, however, the difference in median values is generally about one order of magnitude or less.

TABLE 4.3
COMPARISON OF CONTAMINANT CONCENTRATIONS IN BUFFALO RIVER
BOTTOM SEDIMENTS WITH UPSTREAM CONTROL AREA BOTTOM SEDIMENTS
ERIE COUNTY SAMPLING - 1985
(ug/g)

PARAMETER	BUFFALO RIVER MEDIAN [1]	UPSTREAM CONTROL AREA MEDIAN [2]
acenaphthene	0.000	0.000
acenaphthylene	0.000	0.000
anthracene	0.000	0.000
benz(a)anthracene	0.000	0.480
benzo(a)pyrene	0.815	0.550
benzo(b)fluoranthene	0.266	0.000
benzo(g,h,i)perylene	0.295	0.000
benzo(k)fluoranthene	0.116	0.000
chrysene	0.000	0.000
dibenz(a,h)anthracene	0.122	0.000
fluoranthene	0.000	0.000
fluorene	0.000	0.000
indeno(1,2,3-cd)pyrene	0.583	0.000
naphthalene	0.000	0.000
phenanthrene	0.000	0.000
pyrene	0.475	0.370
aldrin	0.000	0.000
alpha-BHC	0.000	0.000
beta-BHC	0.013	0.000
gamma-BHC	0.000	0.000
2,4'-DDD	0.000	0.000
2,4'-DDE	0.000	0.000
2,4'-DDT	0.000	0.000
4,4'-DDD	0.000	0.000
4,4'-DDE	0.008	0.000
4,4'-DDT	0.000	0.000
dieldrin	0.000	0.000
endrin	0.000	0.000
heptachlor	0.000	0.000
heptachlor epoxide	0.000	0.000

TABLE 4.3 (continued)

PARAMETER	BUFFALO RIVER MEDIAN [1]	UPSTREAM CONTROL AREA MEDIAN [2]
PCB-1 [3]	0.112	0.013
PCB-2	0.000	0.000
PCB-3	0.062	0.003
PCB-4	0.127	0.000
PCB-5	0.189	0.050
PCB-6	0.078	0.000
PCB-7	0.171	0.000
PCB-8	0.000	0.000
PCB-9	0.006	0.000
PCB-10	0.079	0.001
PCB-11	0.034	0.000
PCB-12	0.011	0.000
PCB-13	0.000	0.000
PCB-14	0.002	0.000
PCB-15	0.000	0.000
cadmium	1.691	0.345
chromium	28.915	5.210
copper	65.533	15.550
iron	32183.333	11050.000
lead	97.350	30.400
manganese	612.666	178.500
mercury	0.475	0.000
nickel	38.533	17.900
silver	0.308	0.505
zinc	288.633	52.450

----

[1] 58 cores represent 162 samples
[2] 16 samples
[3] PCBs reported as 15 packed column chlorobiphenyl peaks identified under conditions described by Webb and McCall (1973). Each peak was individually calibrated. Quantification of total PCB is obtained by summing the concentration of individual peaks.

Mean values and contaminant range values for the Buffalo River are presented in Table A.6, Appendix.

Status of Impairments Related to Short-term Goal and Assessment of Their Causes

In the following portion of this Chapter the 14 Great Lakes Water Quality Agreement impairments or impairment indicators are examined relative to the Buffalo River and conclusions are drawn using available data. The causes of the impairments identified are described and assessed.

1. Restrictions on Fish and Wildlife Consumption

Impairment status: Yes.

The New York State Health Department has issued a 1987-88 fish and wildlife advisory to eat no carp from the Buffalo River, based on fish sampling data collected by the Department of Environmental Conservation. The advisory is based on one analysis of a 1984 composite sample consisting of three fish, which found elevated levels of polychlorinated biphenyls (PCBs) at 6.7 ug/g and chlordane at 0.53 ug/g. The State Health Department recommends that in those waters where specific advisories are issued; women of childbearing age, infants, and children under the age of 15 should not eat fish with elevated contaminant levels. Most fish taken from such water bodies would contain elevated contaminant levels.

PCBs have been used as plasticizers, fire retardants and as insulating fluids. Their use is now prohibited by EPA regulation. Chlordane is a pesticide which has been banned in New York State since 1985. The above levels exceeded the Food and Drug Administration's tolerances for these substances in fish, which are 2 ug/g for PCBs and 0.3 ug/g for chlordane. Fish from the river had previously been sampled on six occasions since 1977 (Table 4.4). In these earlier studies, carp samples were found to exceed FDA tolerances for PCBs on four occasions, and mercury standards

TABLE 4.4
BUFFALO RIVER FISH CONTAMINANT DATA
DEC SAMPLING 1977-1984

	1977	1980 Sample 1	1980 Sample 2	1983 Sample 1	1983 Sample 2	1984	FDA Action Levels
Carp							
No. analyzed	10	6	7	9	1	3	
Collection date	July 1	June 2	June 2	May 17	May 17	June 8	
Avg. length (mm)	420	546	468	541	666	741	
Min. length (mm)	356	500	432	505	---	688	
Max. length (mm)	483	602	518	569	---	815	
Avg. weight (g)	1002	2714	1846	2470	4780	7219	
Min. weight (g)	408	2359	1451	2000	---	6647	
Max. weight (g)	2087	3266	2177	2900	---	7990	
% lipid	8.27	10.16	8.24	11.38	12.52	25.66	
Total PCB (ppm)	4.26	0.82	0.69	3.63	14.5	6.67	2.0
Total DDT (ppm)	0.14	0.29	0.30	0.46	0.88	1.63	5.0
Aldrin/dieldrin (ppm)	0.06	<0.01	<0.01	0.01	0.02	0.04	0.3
Endrin (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.3
Heptachlor and its epoxide (ppm)	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.3
Lindane group (ppm)	<0.01	<0.01	<0.01	0.01	0.01	0.04	NAL 1/
Mirex (ppm)	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.1
Mercury (ppm)	0.12	0.14	0.16	0.10	0.12	NA	1.0 2/
Total chlordane (ppm)	NA	0.06	0.05	0.11	0.22	0.53	0.3
Hexachlorobenzene (ppm)	NA	NA	NA	0.01	0.07	<0.01	NAL 1/

1/ NAL - No action level

2/ Methyl mercury

< - less than

NA - Not analyzed

TABLE 4.4 (cont'd)
BUFFALO RIVER FISH CONTAMINANT DATA
DEC SAMPLING 1977-1984

Species	1977 White Sucker	1980 NA	1983 Pumpkinseed Sample 1	1983 Pumpkinseed Sample 2	1984 Brown Bullhd.	FDA Action Levels
No. analyzed	10		10	13	7	
Collection date	June 13		May 17	May 17	June 4	
Avg. length (mm)	283		137	146	322	
Min. length (mm)	231		130	142	313	
Max. length (mm)	318		140	154	345	
Avg. weight (g)	192		62	83	514	
Min. weight (g)	95		50	70	500	
Max. weight (g)	296		70	100	700	
% lipid	1.22		1.16	1.39	4.73	
Total PCB (ppm)	0.71		0.38	0.41	0.87	2.0
Total DDT (ppm)	0.34		0.03	0.04	0.30	5.0
Aldrin/dieldrin (ppm)	0.01		<0.01	<0.01	0.01	0.3
Endrin (ppm)	<0.01		<0.01	<0.01	<0.01	0.3
Heptachlor and its epoxide (ppm)	<0.01		<0.01	<0.01	<0.01	0.3
Lindane group (ppm)	<0.01		<0.01	<0.01	<0.01	NAL 1/
Mirex (ppm)	<0.01		<0.01	<0.01	<0.01	0.1
Mercury (ppm)	0.29		0.14	0.17	NA	1.0 2/
Total chlordane (ppm)	NA		0.01	0.01	0.10	0.3
Hexachlorobenzene (ppm)	NA		<0.01	<0.01	<0.01	NAL 1/

1/ NAL - No action level

2/ Methyl mercury

< - less than

NA - Not analyzed

on one occasion. The FDA action level for chlordane was not exceeded in the earlier samples.

A comparison was made of the analyses of 3 carp taken in 1984 from the Buffalo River with the analyses of 19 carp taken in 1987 from the New York State waters of Lake Erie. The levels in carp of PCBs and chlordane were both elevated in the Buffalo River fish sample relative to the fish samples from Lake Erie. The mean level of PCBs in carp taken in 1987 from Lake Erie was 1.2 ug/g compared to 6.7 ug/g in carp taken in 1984 from the Buffalo River. Similarly, mean chlordane levels in carp taken in 1987 from Lake Erie were 0.052 ug/g compared to 0.53 ug/g in carp taken in 1984 from the Buffalo River.

Based on the PCB and chlordane exceedance of FDA tolerances and the State Health Department consumption advisory, a use impairment for fish and wildlife consumption exists for the Buffalo River. The chlordane exceedance of FDA tolerances, however, occurred in only one sample.

2. Tainting of Fish and Wildlife Flavor

Impairment status: Likely.

The substances of primary concern for tainting of fish in the Buffalo River are phenols (especially chlorinated phenols). Phenols in the water column may taint fish flesh at levels above 5 ug/l, and chlorinated phenols are food-tainting at levels above 1 ug/l. Phenol levels in the Buffalo River measured by the aminoantipyrene method (4AAP) have not been observed above the 5 mg/l level (Table A.1). The mean value of the Buffalo River measurements based on this test is 1.2 ug/l. The results of this test, however, reflects a mixture of both chlorinated and unchlorinated phenolic compounds.

It has been reported that some fish taken from the river have had a noticeable PAH odor in their stomach contents (Dr. John Black, personal observation). Thus, it appears likely that there is potential for tainting of fish flesh from substances present in river sediments. The level of PAHs in the bottom sediments appear to be sufficiently high to cause fish tainting among bottom feeding species. No contaminant data is available for wildlife along the Buffalo River.

3. Degradation of Fish and Wildlife Populations

Impairment status: Likely.

The diversity (number of species and abundance) of fish in the Buffalo River is an important indicator of the health of the ecosystem. A 1928 biological survey of the river conducted by the New York State Conservation Department concluded that the lower Buffalo River was "obviously unfit for eggs or young of fish, and seemed to contain no form of fish life." Current observations of fish populations in the Buffalo River indicate a dramatic change since that 1928 survey. This can be associated with the upgrading of treatment levels and termination of direct continuous municipal and industrial wastewater discharges to the river.

A biological survey of the Buffalo River, Buffalo Harbor and adjacent Lake Erie conducted by Makarewicz et al. in 1981 and 1982 for the U.S. Army Corps of Engineers - Buffalo District indicated that over 20 fish species were observed in the Buffalo River during the spring, summer and fall seasons (Table 4.5).

Carp, white suckers and shiners dominated samples in the river throughout the spring and into summer, but bullheads, gizzard shad and pumpkinseed became more important as summer progressed. In April and early May,

TABLE 4.5
FISH SPECIES OBSERVED IN THE BUFFALO RIVER
AND BUFFALO SHIP CANAL
1981 AND 1982 1/

Scientific Name	Common Name
Clupeidae 2/	
Dorosoma cepedianum	Gizzard shad
Salmonidae	
Salmo gairdneri	Rainbow trout
Salvelinus namaycush	Lake trout
Osmeridae	
Osmerus mordax	Smelt
Esocidae	
Esox masquinongy	Muskellunge
Cyprinidae	
Carassius auratus	Gold fish
Cyprinus carpio	Carp
Cyprinus carpio x Carassius auratus	Carp/goldfish hybrid
Notemigonus crysoleucas	Golden shiner
Notropis atherinoides	Emerald shiner
Notropis cornutus	Common shiner
Notropis hudsonius	Spottail shiner
Pimephales notatus	Bluntnose minnow
Catostomidae	
Catostomus commersoni	White sucker
Moxostoma macrolepidotum	Shorthead redhorse sucker

TABLE 4.5 (CON'T)

Ictaluridae	
Ictalurus nebulosus	Brown bullhead
Percichthyidae	
Morone americana	White perch
Centrarchidae	
Ambloplites rupestris	Rock bass
Lepomis gibbosus	Pumpkinseed sunfish
Lepomis macrochirus	Bluegill sunfish
Micropterus dolomieui	Smallmouth bass
Micropterus salmoides	Largemouth bass
Pomoxis nigromaculatus	Black crappie
Percidae	
Perca flavescens	Yellow perch
Stizostedion vitreum	Walleye
Sciaenidae	
Aplodinotus grunniens	Freshwater drum

1/ Fish collected using gill nets and electrofishing at four sampling sites in the Buffalo River and one sampling site in the Buffalo Ship Canal. Sampling performed from April to December 1981 and during January 1982. Some of the fish collected in the Buffalo River and Buffalo Ship Canal were not found in the Buffalo Harbor and vice versa.

2/ Family

shiners (emerald, spottail and golden) and white suckers dominated the river station fish assemblage. Scattered carp, goldfish, carp goldfish hybrids, yellow perch, drum and bullheads were also found. In late May and June, white suckers dominated with shiners, carp, pumpkinseed, yellow perch and gizzard shad scattered throughout the samples. From July through September, carp, pumpkinseed and gizzard shad dominated the samples, with goldfish, bullheads, white suckers and yellow perch also present. After September, the numbers of fish sampled declined sharply as water temperatures fell and fish movement activity declined. In the cooler water temperatures of spring and fall, occasional salmonids, muskellunge, northern pike and yellow perch were observed at the river stations. Yellow perch were also observed during the summer in the river.

Carp, goldfish, carp-goldfish hybrids, bullheads, pumpkinseed and some white suckers appeared to be year-round river residents. Emerald, spottail and golden shiners and gizzard shad are lake species that utilize the river for spawning in spring and early summer. White suckers, redhorse suckers and freshwater drum are primarily benthic lake species that make spring spawning runs (especially pronounced for white suckers) into the Buffalo River. Muskellunge found in the river may have been foraging on spawning shiners and gizzard shad in the spring. Salmonids and walleye were probably headed upstream to spawn.

Ichthyoplankton (fish larvae) were found in very small numbers at each of the four river stations monitored, indicating limited reproduction. Because so much of the river banks are artificial and drop off quickly to 7 meters (24 feet), the amount of shallow, protected habitat necessary for the survival of the young of most fish species is small.

To assess the character of fish species composition, electrofishing and gill net catch data from the Makarewicz et al. study were pooled for the four Buffalo River stations and four Buffalo Harbor stations by time of collection (generally monthly).

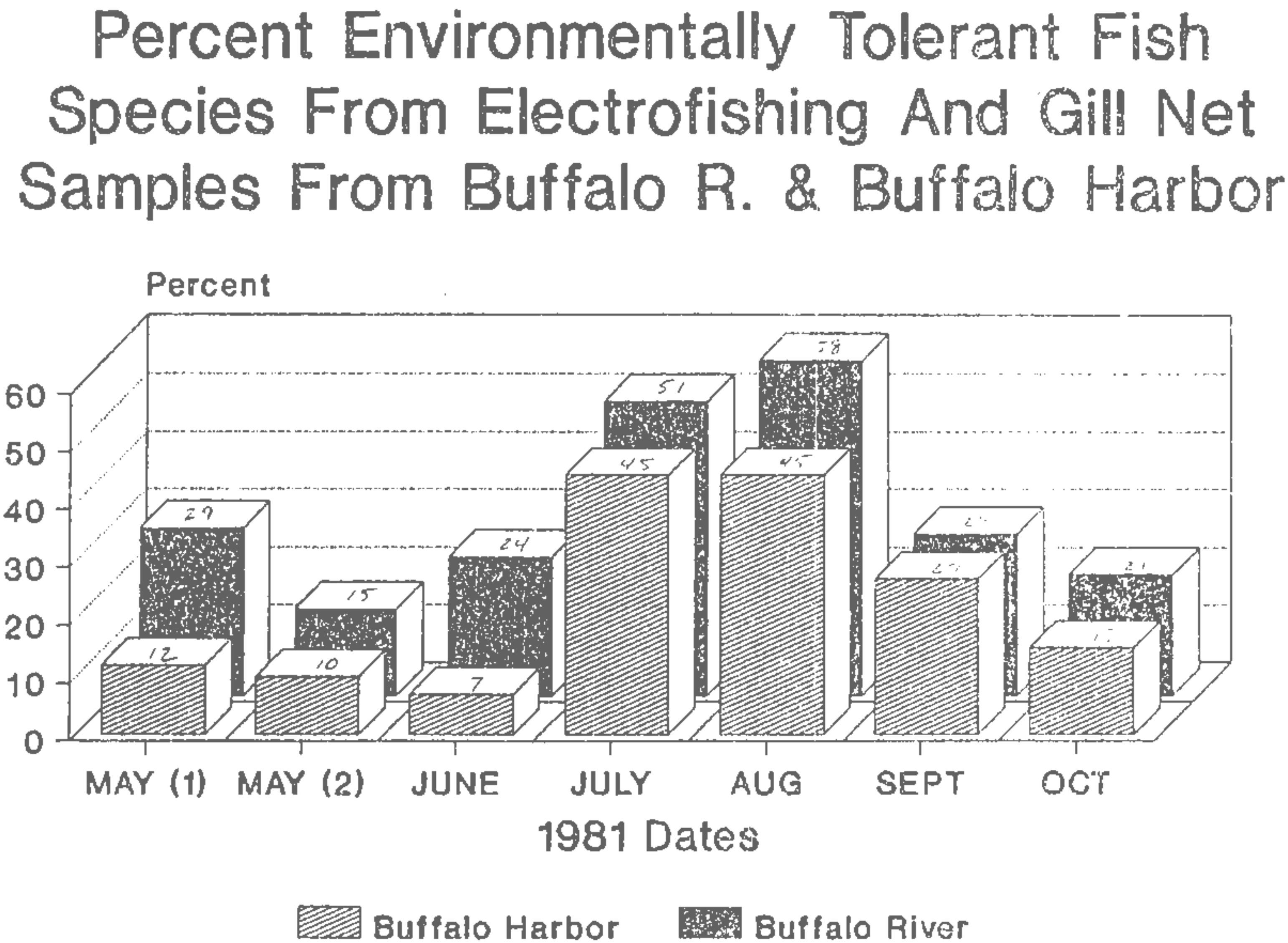
Some fish species observed were categorized as "tolerant" of environmentally degraded conditions and included brown bullhead, carp, goldfish and carp-goldfish. Other fish observed were categorized as "sensitive" and included largemouth bass, smallmouth bass, yellow perch, rock bass, bluegill, crappie, pumpkinseed, muskellunge, northern pike, walleye, gizzard shad, suckers (3 species), freshwater drum and salmonids (3 species).

The total numbers of individuals of "tolerant" species were transformed to a percentage of the total number of fish collected in each monthly pooled sample. Species not likely to be efficiently collected in either gill nets or by electrofishing (eg., small cyprinids, smelt, log perch) were not counted.

The percentages of "tolerant" individuals from Buffalo River versus Buffalo Harbor for each sampling date are compared graphically in Figure 4.2, however, no significance should be attached to the amplitude of the bars. For both river and harbor samples, the percentage of "tolerant" species is highest during the summer, when the dissolved oxygen is naturally likely to be lowest and temperature highest. This is predictable and not indicative of a greater or lesser degree of degradation in either river or harbor.

The percentage of "tolerant" species present in collections was consistently higher for the Buffalo River, when compared to the Buffalo Harbor, but not overwhelmingly

Figure 4.2


Percent Environmentally Tolerant Fish Species From Electrofishing And Gill Net Samples From Buffalo R. & Buffalo Harbor
Percent
60
50
40
30
20
10
0
29
12
15
10
24
7
51
45
58
45
MAY (1)
MAY (2)
JUNE
JULY
AUG
SEPT
OCT
1981 Dates
Buffalo Harbor
Buffalo River

so. This suggests that environmental conditions in the Buffalo River somewhat favor "tolerant" species when compared to Buffalo Harbor.

The magnitudes of the differences in percentages of "tolerant" species would not support an argument that "tolerant" species dominate the Buffalo River compared to Buffalo Harbor. Lakes that formerly supported diverse warmwater fish communities have been observed to become so degraded that species such as carp and bullheads accounted for nearly 100 percent of all fish present. The Buffalo River is not comparable.

The diversity of macroinvertebrate organisms in the water column is an indicator of the health of a waterway to support fish and wildlife populations. Preliminary data from macroinvertebrate samples collected by DEC during the summer of 1987, when compared with similar data obtained from the Buffalo River in 1976 and 1982, indicate that there is good potential to develop diverse macroinvertebrate fauna in the river.

Quantitative data were obtained by exposing hardboard artificial substrates for five week periods near the Ohio Street Bridge on the lower Buffalo River during June, July, and September 1987. The preliminary data used in the comparative analysis consists of the results of the June 1987 sample. Since the sampling device was suspended in the water column rather than placed on the bottom of the river, these results do not necessarily represent current conditions on the bottom of the Buffalo River. The 1987 sampling data represent the potential bottom community that could develop under suitable conditions.

The richness (number of species) of the macroinvertebrate fauna has improved through each period from 1976 to 1982 and from 1982 to 1987. For each of these periods there has also been a dramatic change in the diversity (combination of species evenness and richness) of fauna in the Buffalo River. In June 1976, the species diversity index value was 1.41. This increased to 2.23 in 1982, and to 3.46 for the June 1987 sample. A value of one to two indicates poor to fair diversity, two to three fair to good diversity, and greater than three is defined as good to excellent diversity. Observations made during this period have not indicated the presence of caddisfly (Trichoptera) or mayfly (Ephemeroptera) nymphs. A consistent dissolved oxygen level of 5.0 mg/l would be required to support these organisms.

Observations based on the total number of individual organisms in 1987 indicate reduced organic enrichment levels, in comparison to 1982. However, the biotic index of all organisms collected in each sample, which reflects the organisms' tolerance to organic enrichment, has decreased only slightly from 1976 to 1987 (from 4.69 to 4.37). Both of these values would be in the "fair to poor" range. Organic enrichment reduces dissolved oxygen levels. It can result from waste contributions and natural sediment deposits from the watershed. Bottom sediment disturbance associated with dredging, stream flow variation, and propeller wash from commercial navigation would result in organic release to the waterway. While organic waste contributions to the Buffalo River have been reduced during this period, no changes have occurred which would reduce natural sediment deposition or disturbance.

Low levels of dissolved oxygen were probably the primary limiting factor in the past for fish populations in the Buffalo River. The biological survey of the river conducted by the New York State Conservation Department in

1928 indicated that the oxygen concentration at the mouth of the Buffalo River was zero.

In recent years, summer dissolved oxygen levels in the lower river have generally remained above the 3.0 mg/l level specified by New York State standards for fish survival, based on random grab samples collected once each month from 1982 to 1986 one meter below the water surface by the Department at the Ohio Street Bridge station (Table 4.6). While these data were obtained during the summer low river flow period when dissolved oxygen is likely to be lowest, they represent only mid-day conditions at one point on the Buffalo River. The data also suggest that if the Buffalo River is reclassified from its current class "D" (fishing) designation to Class "C" (fish propagation) or higher, the dissolved oxygen standard may not be achieved in summer months. Class "C" standards for non-trout streams require a minimum daily average of 5.0 mg/l dissolved oxygen, with no sample below 4.0 mg/l.

A limnological study of the Buffalo River was conducted in 1982 for the Buffalo River Improvement Corporation by Ecology and Environment, Inc. Sampling was conducted at three stations along the Buffalo River on June 2, June 9 and August 12, 1982. The sampling stations were located 50 meters downstream of the confluence with Cazenovia Creek (Mile Point 5.8), 20 meters downstream of the Lower Conrail Bridge (Mile Point 3.7) and 20 meters downstream of the Michigan Avenue Bridge (Mile Point 1.1) (Figure 4.3).

The data generated during the sampling on August 12, 1982, the day with the lowest flow (Table 4.7) indicates that the dissolved oxygen content was generally constant with depth at all three stations. The mean dissolved oxygen value of 6.3 mg/l at the upstream station (near the confluence of the Buffalo River with Cazenovia

TABLE 4.6
BUFFALO RIVER DISSOLVED OXYGEN LEVELS
OHIO STREET BRIDGE
1982-1986

Yr/Month	Flow (mgd)	Dissolved Oxygen (mg/l)	Temperature °C	Dissolved Oxygen Saturation Value (mg/l)	Percent Saturation
1982					
July	141	3.2	24	8.4	38
August	58	3.9	24	8.4	46
1983					
July	34	6.4	22	8.7	74
August	34	3.4	24	8.4	40
1984					
July	63	6.0	25	8.3	72
August	68	6.8	23	8.6	79
1985					
July	108	4.8	20	9.1	53
August	42	5.0	23	8.6	58
1986					
July	290	3.4	24	8.4	40
August	125	NA	24	8.4	NA

NA - Not Analyzed

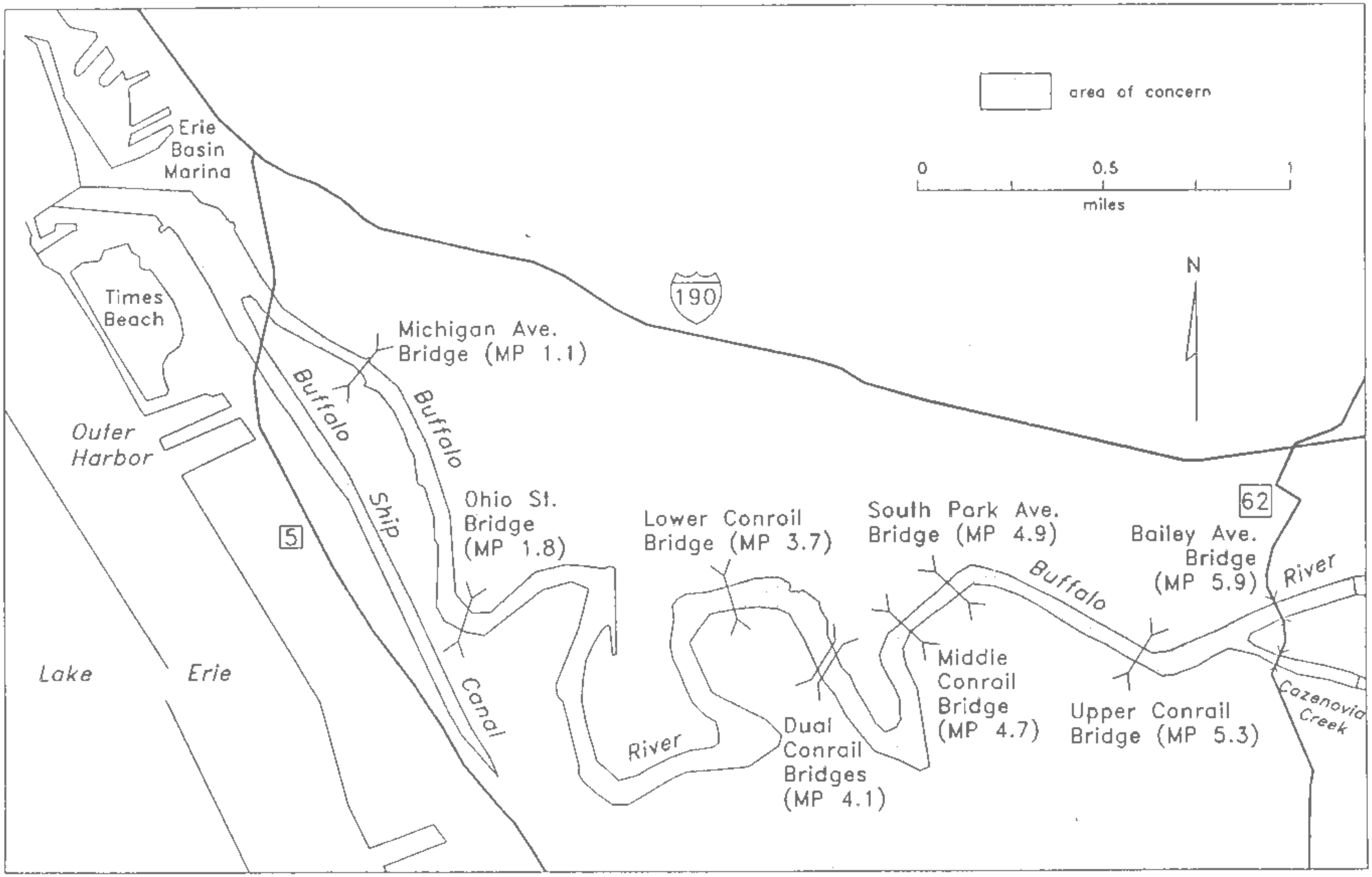


Figure 4.3 Location and Mile Point (MP) of Bridges
Along the Buffalo River

TABLE 4.7
DISSOLVED OXYGEN AND ASSOCIATED PARAMETER SAMPLING DATA [1]
BUFFALO RIVER
JUNE 2, 1982

	Confluence With Cazenovia Creek [2] Mile Point 5.8				Conrail Bridge [2] Mile Point 3.7				Michigan Avenue Bridge [2] Mile Point 1.1			
Depth [3] (m)	Temperature (C)	Percent Saturation (%)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)	Temperature (C)	Percent Saturation (%)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)	Temperature (C)	Percent Saturation (%)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)
0.5	23.0	98	8.5	357	22.0	99	8.7	287	21.0	105	9.5	237
1.5	23.0	82	7.1	347	22.0	64	5.5	287	21.0	98	8.8	237
2.5	23.0	74	6.4	317	22.0	56	5.0	287	21.0	98	8.8	237
3.5	23.0	71	6.2	307	20.0	54	5.1	287	19.0	95	8.8	237
4.5	24.0	62	5.4	307	19.0	54	5.1	297	18.0	76	7.3	237
5.5			-----		19.0	54	5.1	307	18.0	76	7.3	237
6.5			6.7 [4]		19.0	54	5.1	287	18.0	76	7.3	237
7.5	SECCHI DEPTH, 0.5 M				19.0	54	5.1	287	18.0	75	7.2	237
8.5					18.0	66	6.3	292	18.0	75	7.2	237
9.5					18.0	66	6.3	292	18.0	76	7.3	257
							-----				-----	
							5.7 [4]				8.0 [4]	
					SECCHI DEPTH, 1.5 M				SECCHI DEPTH, 3.0 M			

----

[1] Data collected and analyzed by Ecology & Environment.

[2] Sampling stations located 50 meters downstream of Buffalo River confluence with Cazenovia Creek, 20 meters downstream of Conrail Bridge and Michigan Avenue Bridge.

[3] Samples collected to river bottom at each station.

[4] Mean station value.

TABLE 4.7 (con't.)
DISSOLVED OXYGEN AND ASSOCIATED PARAMETER SAMPLING DATA [1]
BUFFALO RIVER
JUNE 9, 1982

	Confluence With Cazenovia Creek [2] Mile Point 5.8				Conrail Bridge [2] Mile Point 3.7				Michigan Avenue Bridge [2] Mile Point 1.1			
Depth [3] (m)	Temperature (C)	Percent Saturation (%)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)	Temperature (C)	Percent Saturation (%)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)	Temperature (C)	Percent Saturation (%)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)
0.5	21.0	76	6.9	397	18.0	68	6.6	367	14.5	70	7.3	267
1.5	18.0	69	6.8	387	17.0	62	6.1	362	13.5	67	7.1	269
2.5	16.0	64	6.4	382	16.0	62	6.2	357	12.5	62	6.8	272
3.5	15.0	58	6.0	377	16.0	56	5.6	342	11.3	59	6.6	262
4.5	15.0	57	5.8	387	15.5	54	5.4	342	8.2	60	7.2	237
5.5			-----		14.0	52	5.4	337	7.0	62	7.6	231
6.5			6.4 [4]		14.0	56	5.8	302	6.0	68	8.6	229
7.5	SECCHI DEPTH, 0.5 M				13.0	50	5.3	307	6.0	68	8.6	229
8.5					13.0	50	5.3	307	6.0	68	8.6	229
9.5					13.0	50	5.3	307	6.0	53	9.0	225
							-----				-----	
							5.7 [4]				7.7 [4]	
					SECCHI DEPTH, 0.75 M				SECCHI DEPTH, 0.5 M			

----

[1] Data collected and analyzed by Ecology & Environment.

[2] Sampling stations located 50 meters downstream of Buffalo River confluence with Cazenovia Creek, 20 meters downstream of Conrail Bridge and Michigan Avenue Bridge.

[3] Samples collected to river bottom at each station.

[4] Mean station value.

TABLE 4.7 (con't.)
DISSOLVED OXYGEN AND ASSOCIATED PARAMETER SAMPLING DATA [1]
BUFFALO RIVER
AUGUST 12, 1982

	Confluence With Cazenovia Creek [2] Mile Point 5.8				Conrail Bridge [2] Mile Point 3.7				Michigan Avenue Bridge [2] Mile Point 1.1			
Depth [3] (m)	Temperature (C)	Percent Saturation (%)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)	Temperature (C)	Percent Saturation (%)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)	Temperature (C)	Percent Saturation (%)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)
0.5	20.0	73	6.7	435	22.0	48	4.2	390	22.0	52	4.6	365
1.5	20.0	68	6.3	435	22.0	39	3.5	395	22.0	49	4.3	360
2.5	20.0	68	6.3	435	22.0	36	3.2	405	22.5	41	3.6	360
3.5	21.0	67	6.0	445	22.0	31	2.8	405	22.5	41	3.6	360
4.5	21.0	67	6.0	445	22.0	31	2.8	405	22.5	41	3.6	360
5.5			-----		22.0	36	3.2	405	22.5	41	3.6	360
6.5			6.3 [4]		22.0	36	3.2	405	22.5	43	3.8	350
7.5	SECCHI DEPTH, 0.5 M				22.0	36	3.2	405	22.0	49	4.3	345
8.5					22.0	36	3.2	405	22.0	42	3.7	345
9.5							-----		22.0	42	3.7	355
							3.3 [4]				-----	
					SECCHI DEPTH, 1.0 M						3.9 [4]	
									SECCHI DEPTH, 1.0 M			

----

[1] Data collected and analyzed by Ecology & Environment.

[2] Sampling stations located 50 meters downstream of Buffalo River confluence with Cazenovia Creek, 20 meters downstream of Conrail Bridge and Michigan Avenue Bridge.

[3] Samples collected to river bottom at each station.

[4] Mean station value.

Creek) decreased to 3.2 mg/l immediately below the major industrial zone at the Lower Conrail Bridge station and increased to 3.9 mg/l at the Michigan Avenue station. The stream flow during this August 12, 1982 sampling was 60 mgd of which 23 mgd was water pumped by the Buffalo River Improvement Corporation (BRIC). The biochemical oxygen demand was less than 2.0 mg/l (a natural background level) at all three stations. Measurement of specific conductance of each of the three stations also indicated that the water quality was essentially uniform with depth.

A similiar sampling on June 2, 1982 indicated mean dissolved oxygen levels at the three stations (upstream to downstream) of 6.7, 5.7 and 8.0 mg/l. The total stream flow on June 2, 1982 was 196 mgd of which 78 mgd was BRIC pumpage. On June 9, 1982 mean dissolved oxygen values at the three stations (upstream to downstream) were 6.4, 5.7 and 7.7 mg/l. Stream flow totaled 188 mgd of which 32 mgd was pumped by BRIC.

Samples for chemical analyses were collected in mid-stream at mid-depth at each station during this 1982 survey (Table 4.8). Contrasting the observations in 1982 with those from previous years (Oleszko, 1976; Sauer, 1979; Sweeney and Merckel, 1972), an improvement in water quality is evident. Since 1976 the largest positive changes appear to have occurred at the upstream station, probably as a result of reduction of domestic sewage inputs. Immediately below the most heavily industrialized zone of the river (Lower Conrail Bridge station), marked reductions in chemical oxygen demand (COD), were evident. For example, at that site in 1972 COD averaged over 125 mg/l and at times exceeded 200 (Sweeney and Merckel, 1972). These are in contrast to generally less than 50 mg/l COD in 1982. Sauer (1979) reported biochemical oxygen demand (BOD) mean concentrations of nearly 40 mg/l in the 1940-49 period

TABLE 4.8
CHEMICAL SAMPLING DATA [1]
BUFFALO RIVER
1982

Parameters (mg/l)	June 2, 1982			June 9, 1982			August 12, 1982		
	Confluence with Cazenovia Creek [2] (MP 5.8)	Conrail Bridge [2] (MP 3.7)	Michigan Avenue Bridge [2] (MP 1.1)	Confluence with Cazenovia Creek [2] (MP 5.8)	Conrail Bridge [2] (MP 3.7)	Michigan Avenue Bridge [2] (MP 1.1)	Confluence with Cazenovia Creek [2] (MP 5.8)	Conrail Bridge [2] (MP 3.7)	Michigan Avenue Bridge [2] (MP 1.1)
Chlorine Demand	3.02	2.08	1.65	1.90	3.37	1.79	0.35	1.37	0.56
Total Iron	0.953	0.961	0.753	0.814	1.06	0.853	0.556	0.417	0.448
Chemical Oxygen Demand	24.6	24.6	8.8	16.3	16.3	25.6	52.3	31.1	34.6
5-Day Biochemical Oxygen Demand	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Total Suspended Solids	35	35	38	14	19	20	8	6	10
Total Dissolved Solids	377	341	290	226	186	175	202	232	204
Total Solids	412	376	318	240	205	195	210	238	214
Ammonia Nitrogen (as N)	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Total Chlorides	23.4	33.5	32.1	27.2	21.0	19.1	44.8	33.3	28.7

----

[1] Data collected and analyzed by Ecology & Environment.

[2] Sampling stations located 50 meters downstream of Buffalo River confluence with Cazenovia Creek, 20 meters downstream of Conrail Bridge and Michigan Avenue Bridge.

MP Mile point.

compared to about 7 mg/l in 1968-70 shortly after BRIC was operational. All of the 1982 values were less than 2 mg/l. Similarly the immediately pre and post BRIC chlorides levels were 125 and 58 mg/l (Sauer, 1979). The 1982 observations were no higher than 45 mg/l and generally less that 30 mg/l. Recent reductions in chlorides and BOD probably were caused by abatement of domestic pollutants discharged to the Buffalo River watershed.

Current exceedance frequency of New York State water quality standards and criteria determined from water samples collected from 1982 to 1986 at the Ohio Street Bridge on the Buffalo River is shown in Table A.2, Appendix). These data indicate that for all of the parameters analyzed, the standards and criteria for fish and fish propagation (Class C stream designation) were exceeded in generally less than 10 percent of the samples for zinc, chromium, lead, mercury and pH.

It is likely that fish populations and fish spawning in the river are degraded, however, it is not clear what factors may be limiting. Possibilities include low dissolved oxygen, siltation, other habitat degradation, and chemical contamination. The relative absence of shallow vegetated areas along portions of the highly channelized river may be a significant factor related to spawning and rearing inhibition.

There is also little quantitative information about wildlife populations on and around the Buffalo River. Waterfowl are frequently observed on the river, and mammals such as muskrats have established themselves in nearby wetland areas at Tifft Farm and Times Beach, where there is some isolation from the surrounding urban area.

4. Fish Tumors and Other Deformities

Impairment Status: Yes.

High levels of fish tumors are both an indicator of contaminant stresses in the ecosystem, and an interference with human uses of the resource such as fishing and fish consumption. They may also constitute a health risk, if human carcinogens are present in the flesh of food fish.

Black et al. (1985) have shown that extracts of Buffalo River sediments induce fish tumors and that feral brown bullhead caught in the Buffalo River appear to have a high prevalence of neoplasms. The authors believe that PAHs (byproducts of coke manufacturing and combustion) play a role in this etiology but the specific substances are not known. Mice skin painting experiments show that benzo(a)pyrene, a well known carcinogenic PAH, is unlikely to account for all of the observed effects. Skin painting with benzo(a)pyrene plus Buffalo River sediment extracts produced more skin tumors in mice than benzo(a)pyrene alone.

The National Research Council in 1985 stated: "Polynuclear aromatic hydrocarbons also have been implicated in harm to biota. Links have been found between the presence of these compounds in bottom sediments and the development of neoplastic disease (cancerous tissue growth) in several different kinds of bottom dwelling/feeding fish species from both marine water and freshwater, including the waters of the Great Lakes where the cancers in some cases are epidemic in proportion (Black, 1983, 1984a; Baumann et al., 1982). These field observations are reinforced by laboratory data that indicate that fish, including some of the very species which exhibit the cancers in the polluted environments, develop histologically similar tumors when exposed to those pollutants in the laboratory (Hendricks, 1982; Black, 1984b; Black et al., 1985). Because polynuclear aromatic hydrocarbons are not recognized as liver carcinogens on the basis of their activity in mammals, it has been difficult to accept the idea that these agents may be the cause of the liver cancers in the wild fish populations. Recent biochemical studies have provided insight as to why these compounds can readily cause neoplastic and preneoplastic liver lesions in fish. In brief, it appears that fish produce greater amounts of the carcinogenic metabolites of these compounds, at least as based on studies of the metabolism of 3,4-benzo(a)pyrene (Nishimoto and Varanasi, 1985). Recent work has confirmed that polyaromatic hydrocarbons including 3,4-benzo(a)pyrene do cause cancer in fish."

Additional references where benzo(a)pyrene/polynuclear aromatics have caused cancer in trout include Hendricks et al., 1985; Black et al., 1988; and Hawkins et al., 1988.

The incidence of fish tumors in the Buffalo River is believed to be high based on studies completed by Black et al. in the late 1970's and early 1980's. Currently, fish tumor incidence data is being collected and analyzed under a fish contaminants study for the Niagara River including the Buffalo River. This investigation is being conducted by the U.S. Fish and Wildlife Service in conjunction with biological researchers at area institutions and universities.

Some tumors in fish, including brown bullheads, have causes other than chemical contamination (e.g. are spontaneous or induced by virus), but liver neoplasia and skin neoplasia have been accepted as documentable, chemically induced cancer injury in fish (U.S. Department of Interior, 1987). Other neoplasia (eg. oral papilloma in fish) are not adequate evidence of chemical cause because they are known to develop in the absence of chemical contaminants.

Black et al. (1980), Black (1983), Black et al. (1985), Dunn et al. (1987), Black (1988) and Maccubbin et al.(1988) show that extracts of Buffalo River sediments cause liver and skin neoplasia in brown bullheads, that PAHs are found in high concentrations in Buffalo River sediments, that the neoplasia in brown bullheads is chemically induced and that the presence of high levels of carcinogenic PAH metabolites in Buffalo River brown bullheads indicates that these fish are receiving significant PAH exposure (See Table A.3 and A.6, Appendix, for DEC and Erie County measurements of PAHs in the Buffalo River). The evidence is very strong. One can infer that the elevated liver and skin neoplasia in Buffalo River brown bullheads is caused partly at least by PAHs in the river sediments. Other causative agents associated with sediments cannot be ruled out.

Mutagenicity in sediments is often associated with PAHs (Litten et al. 1983) but mutagenicity screens conducted by DEC [Ames Salmonella testing with and without S-9 (rat liver extract) activation of bacterial strains TA-98 and TA-100] of sediment extract fractions suggest that substances other than PAHs are most active in some Buffalo River sediments.

The sediment extracts showing the most mutagenic activity were divided into acid extractable, base extractable and neutral extractable fractions. These fractions were retested using the Ames test and the most active fraction (neutral) was then subdivided using solvents with a range of polarities into ten neutral subfractions. PAHs appeared in the early subfractions (identified by gas chromotography/mass spectroscopy). These subfractions showed mutagenic activity, however, later subfractions, which did not contain PAHs also showed mutagenic activity which in some instances was greater than in those fractions containing PAHs. These other substances have not been identified.

Criteria for acceptable levels of PAHs and other carcinogenic substances in sediments need to be developed.

5. Bird or Animal Deformities or Reproduction Problems

Impairment status: Likely.

There are no data available to indicate whether pollution of the Buffalo River is causing bird or animal deformities or reproduction problems. Some of the contaminants found in river sediments have been shown to move through the food chain, and in other parts of the Great Lakes basin, bird deformities have been associated with chemical contamination. The relatively small size of the lower Buffalo River (5.8 miles in length with an average width of 200 feet) would limit potential exposure but the open water is readily accessible to piscivorous (fish eating) birds. Levels of PCBs and DDT (and metabolites) (6.7 ug/g and 1.6 ug/g respectively in carp collected in 1984) in Buffalo River adult fish pose a risk of toxicity to piscivorous wildlife which may inhabit the river. PCB levels above the DEC criterion (0.11 ug/g) to protect fish eating wildlife were also observed in young-of-year spottail shiners collected by DEC in 1985 (0.90 ug/g) and 1987 (0.14 ug/g) from the Buffalo River (Table 4.9).

While there are no data to indicate bird or animal deformities or reproduction problems, the exceedance of criteria suggest that such impairment is likely.

TABLE 4.9
BUFFALO RIVER FISH CONTAMINANT DATA
YOUNG-OF-YEAR SPOTTAIL SHINERS
DEC SAMPLING
(ug/g)

Parameter	DEC Criteria	Detection Limit	Concentration 1985	Concentration 1987
aldrin	0.022 1/	0.001	ND	ND
Aroclor 1016/1248	0.11 2/	0.02	0.350	0.048
Aroclor 1254/1260	0.11 2/	0.02	0.450	0.096
p,p' - DDE	0.2 3/	0.005	0.041	0.011
p,p' - DDD	0.2 3/	0.005	0.034	0.008
p,p' - DDT	0.2 3/	0.005	ND	ND
mirex	0.33 4/	0.005	ND	ND
photomirex	0.33 4/	0.005	ND	ND
cis-chlordane	0.37 5/	0.005	ND	ND
trans-chlordane	0.37 5/	0.005	ND	ND
dieldrin	0.022 1/	0.002	0.005	ND
hexachlorobenzene	0.2	0.002	ND	ND
trans-nonachlor	0.37 5/	0.005	ND	ND
oxychlordane	0.37 5/	0.005	ND	ND
a-BHC	NC	0.001	ND	ND
b-BHC	NC	0.001	ND	ND
d-BHC	NC	0.001	ND	ND
g-BHC	NC	0.001	ND	ND

ND - Not Detected
NC - No Criteria
1/ - Total for aldrin/dieldrin
2/ - Total for PCB Aroclors
3/ - Total for DDT, DDE & DDD
4/ - Total for mirex and photomirex
5/ - Total for chlordane isomers

6. Degradation of Benthos

Impairment status: Yes

Bottom-dwelling organisms serve both as a food source for higher organisms such as fish, and as an indicator of pollutant stresses. Measurements of benthic macroinvertebrates were made as part of the limnological study conducted in 1982 for the Buffalo River Improvement Corporation. The measurements made at each of three stations along the Buffalo River on June 2, June 9 and August 12, 1982 are shown in Table 4.10.

The macroinvertebrates observed included Oligachaeta (sludgeworms), Gastropoda (snails), Pelecypoda (clams), Turbellaria (flatworms), Hirudinea (leeches) and Diptera (flies). While there has been improvement in diversity and numbers from earlier studies, the benthic organisms collected in 1982 are typical of those found in organically contaminated sediments.

In evaluating the benthos of the Buffalo River, bioassay testing of organisms that live either on or directly above the sediments provides an indication of the environmental conditions at and near the river bottom. Limited bioassay investigations of organisms exposed to Buffalo River sediments were undertaken by DEC to assess acute toxicity, chronic toxicity and bioaccumulation.

Acute toxicity tests were performed by 48 hour exposures of Daphnia magna and ten day exposures of Hyalella azteca. Although both are crustaceans, Daphnia swim in the water overlying the sediment while the Hyalella are bottom dwellers that walk on the sediment surface. Fifteen Daphnia and ten Hyalella were exposed in the same beaker containing

TABLE 4.10
BENTHIC MACROINVERTEBRATE DATA
BUFFALO RIVER
1982
(Organisms per square meter)

TAXA	June 2, 1982 Confluence with Cazenovia Creek [2] (MP 5.8)	June 2, 1982 Conrail Bridge [2] (MP 3.7)	June 2, 1982 Michigan Avenue Bridge [2] (MP 1.1)	June 9, 1982 Confluence with Cazenovia Creek [2] (MP 5.8)	June 9, 1982 Conrail Bridge [2] (MP 3.7)	June 9, 1982 Michigan Avenue Bridge [2] (MP 1.1)	August 12, 1982 Confluence with Cazenovia Creek [2] (MP 5.8)	August 12, 1982 Conrail Bridge [2] (MP 3.7)	August 12, 1982 Michigan Avenue Bridge [2] (MP 1.1)
Oligachaeta (sludge worms)	711	44.977	115,555	444	40,000	127,778	792	18,468	801
Gastropoda (snails)	0	0	1,777	0	0	1,977	0	267	89
Pelecypoda (clams)	0	0	177	0	0	89	0	178	401
Turbellaria (flatworms)	NR	NR	NR	NR	NR	NR	0	0	45
Hirudinea (leeches)	NR	NR	NR	NR	NR	NR	0	45	134
Diptera (flies)	NR	NR	NR	NR	NR	NR	579	89	45

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[1] Data collected and analyzed by Ecology & Environment.

[2] Sampling stations located 50 meters downstream of Buffalo River confluence with Cazenovia Creek, 20 meters downstream of Conrail Bridge and Michigan Avenue Bridge.

MP Mile point.

NR Not reported. Believed to be of insufficient size to be retained on a U.S. Standard No. 30 sieve (0.595-mm opening).

200 ml of sieved sediment and 800 ml of water. All tests were performed in triplicate.

The results of the *Daphnia* testing are shown in Table 4.11.

TABLE 4.11
ACUTE TOXICITY TESTING
DAPHNIA SURVIVORS (OF 15 ORGANISMS)
BUFFALO RIVER
1985

Test	Sample	Set 1	Set 2	Set 3
Initial Test	Control Site	15	15	15
		15	15	15
		15	15	15
	Dilution Water	13	15	15
		15	15	15
		15	15	13
	Buffalo River	10	13	15
	Buffalo Ship Canal	13	14	15
Repeated Test	Control Site	15	15	14
	Buffalo River	10	10	2
	Buffalo Ship Canal	15	15	15

In the Buffalo River test, a number of organisms died air-locked in the surface tension of the exposure vessels.

In the initial testing of *Hyalella*, problems with survival were noted and the test was repeated. Results of the second test are presented in Table 4.12.

TABLE 4.12
ACUTE TOXICITY TESTING
HYALELLA SURVIVORS (OF 10 ORGANISMS)
BUFFALO RIVER
1985

Sample	Set 1	Set 2	Set 3
Control Site	10	10	8
Buffalo River	6	3	7
Buffalo Ship Canal	8	10	10

The Buffalo River samples did have an effect on Hyalella survival. The Buffalo Ship Canal sample had little effect on survival.

Chronic toxicity testing was performed using the elutriate of sediment samples taken from 20 Buffalo River sites. Seven day assays were performed which consisted of exposing ten neonate Ceriodaphnia dubia in individual polystyrene cups holding a small amount of elutriate. Survival and reproductive success was recorded for each individual.

The results of the chronic toxicity tests are presented in Table 4.13. The samples represented two groups of sites sampled one month apart in 1985. The September samples showed high mortality and low reproduction. The October samples had excellent survival and reproduction. No relationship was observed between contaminant concentrations in the elutriates and the Ceriodaphnia results. No assignable cause could be determined for the difference. Evaluation of these results suggests that laboratory variability was a dominant factor.

TABLE 4.13

CHRONIC TOXICITY TESTING OF <u>CERIODAPHNIA DUBIA</u>

BUFFALO RIVER

1985

Sample Nos.	% Survival at 7 days	Mean reproductive rate young/female at 7 days
September 1985		
735-3-18 [1/]	0	0
736-1-11	0	0
737-1-8	0	0
742-2-3	20	2
743-1-5	40	7
744-1-5	40	9.1
746-1-13	0	0
747-4-8	0	0.8
750-2-7	50	13.2 [3/]
751-2-7	50	5.4
October 1985		
738-4-8	100	21.0
741-4-8	100	15.8
741-5-8	100	18.8
742-1-16	90	19.4
745-1-15	100	20.0
805 [2/]	100	20.7
806 [2/]	80	12.3
808 [2/]	100	25.7 [3/]
809 [2/]	100	18.9
814 [2/]	100	18.9

See following page for footnotes

Footnotes (Table 4.13)

1/ (735) USACOE Buffalo River transect number at Mile Point 4.43. Transects are spaced at 100 foot intervals.

(3) Position on transect. Samples generally were taken at 5 positions on transect; at the 10 foot and 18 foot depth below low water datum and at the channel center. Position 1 is closest to the north bank.

(18) Depth of core in cm to centerline of sample slice.

2/ Control area samples located above the lower Buffalo River.

3/ Test control samples; highest mean reproductive rate for each test.

DEC bioaccumulation experiment results consist of contaminant concentrations; in sediments before and after a 28-day fish exposure, in recirculated water after 28 days, and in fish flesh (corrected for lipid content) after exposure for 1.75, 3.5, 7, 14, and 28 days. The test organism was Pimephales promelas (fathead minnow). Analyses were performed for priority pollutant pesticides and PCBs, mirex and chlorobenzenes. Sediments were also analyzed for priority pollutant metals.

The results of the bioaccumulation testing are shown in Table 4.14. Control samples indicate that the test water or the test fish were contaminated with p,p'-DDE. Test results for this substance are therefore suspect. The experiments show evidence of uptake of heptachlor epoxide and Aroclor 1248 in the Buffalo River sample. Some uptake of PCBs was shown for the Buffalo Ship Canal sample. None of the contaminants found in the fish were observed in the sediments or water. The Buffalo River and Buffalo Ship Canal sediments did not show unusual bioavailability.

Because of air-locking the tests indicated the sediments caused no direct acute toxicity effect on Daphnia magna although the Buffalo River sediments did have an effect on Hyalella azteca survival. Chronic toxicity exposure of Ceriodaphnia dubia to two samples indicated high mortality and low reproduction in one sample but the effects were not related to elevated contaminant concentrations. Bioaccumulation experiments with Pimephales promelas indicated that none of the contaminants found in the test organisms were observed in the sediments. These investigations indicate that the selected Buffalo River sediments effect Hyalella azteca survival.

TABLE 4.14
BIOACCUMULATION TESTING
PIMEPHALES PROMELAS EXPOSURE TO
BUFFALO RIVER BOTTOM SEDIMENT ELUTRIATES
1985

Parameter	Sediment		Water	Fish				
	0 Days	28 Days	28 Days	1.75 Days	3.5 Days	7 Days	14 Days	28 Days
Buffalo River								
p,p' - DDE	ND	ND	ND	0.03	0.02	0.02	0.16	0.03
PCB (Aroclor-1248)	ND	ND	ND	ND	ND	ND	ND	0.6
Pentachlorobenzene	ND	0.004	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	0.04	ND	ND	ND	0.28
Buffalo Ship Canal								
p,p' - DDE	ND	ND	ND	ND	0.02	0.01	0.02	0.02
PCB	ND	ND	ND	ND	ND	0.01	ND	ND
Hexachlorobenzene	0.006	ND	ND	ND	ND	ND	ND	ND
Control								
p,p' - DDE			0.04 1/					0.02 2/

Notes: Only parameters with detected values are listed
Sediment and fish data concentrations in ug/g
Water data concentrations in ug/l
Maximum values are given
ND not detected
1/ 14 days
2/ 0.02 ug/g value observed on 4 of 6 samples, remaining 2 were ND

The macroinvertebrate observations and *Hyalella* tests indicate impairment of benthos in the Buffalo River. The cause appears to arise from the bottom sediments.

7. Restrictions on Dredging Activities

Impairment status: Yes.

Commercial shipping is an economically beneficial use of the Buffalo River that can be impaired by polluted sediments. Commercial shipping is dependent upon dredging of the navigational channel on the lower Buffalo River, and the cost of dredging is substantially increased because polluted sediments can no longer be disposed in open lake waters. The confined disposal facility currently used by the U.S. Army Corps of Engineers to dispose of dredge spoil, which cost $15.4 million to construct, will be filled to capacity by the mid-1990's.

The evaluation of bottom sediment data collected by the U.S. EPA, Region V (1981), the U.S. Army Corps of Engineers, Buffalo District (1981) and Erie County (1985) indicate that contaminant levels in sediments from the Buffalo River exceed open lake disposal criteria. Median parameter levels and dredging criteria are presented in Table 4.15. The median values of eight substances exceed the dredging criteria for the Buffalo River. The substances are arsenic, barium, copper, iron, lead, manganese, zinc and cyanide.

8. Eutrophication or Undesireable Algae

Impairment status: No

Eutrophication refers to a process in which nutrients and organic matter inputs from a watershed increase

TABLE 4.15
BUFFALO RIVER BOTTOM SEDIMENT
OPEN LAKE DISPOSAL
SCREENING
(ug/g)

Parameter	USEPA Dredging Guidelines	USEPA V Sampling Median 1/	USACOE Sampling Median 2/	Erie Co. Sampling Median 3/
PCBs	10	0.14	0.45	0.87
Arsenic	8	NA	10.9	NA
Barium	60	93	NA	NA
Cadmium	6	0	1.15	1.7
Chromium	75	36	30.35	28.9
Copper	50	55	63.85	65.5
Iron	25000	27000	27250	32183
Lead	60	90	121	97.4
Manganese	500	550	483.5	612.7
Mercury	1	0.5	0.54	0.5
Nickel	50	32	36.75	38.5
Zinc	200	180	390.7	288.6
Cyanide	0.25	1.35	0.33	NA

NA - Not analyzed

1/ - 15-17 Samples

2/ - 12 Samples

3/ - 58 Cores, represent 162 samples

Mean values and contaminant range values are presented in Tables A.3, A.4 and A.6, Appendix.

photosynthetic activity with overproduction of algae, reduced transparency and oxygen depletion.

Secchi disc transparency (light penetration) data collected in 1979 by Ward does not appear to be significantly influenced by algal concentrations, as measured by chlorophyll a, judging from the variation in chlorophyll a data independent of changes in water clarity.

Phosphorus and nitrogen levels in the Buffalo River (Table A.1, Appendix) would be indicative of highly eutrophic conditions in quiescent waters, while the chlorophyll levels indicate only moderate productivity. Given the high dissolved solids concentrations and turbidity, it is most likely that water transparency is most significantly influenced by dissolved material and detritus (non-living particulate matter).

Eutrophic streams exhibit supersaturated dissolved oxygen levels during warm daylight hours, especially in the surface layers. This condition did not exist in 8 out of 9 samplings in the June 2, June 9 or August 12, 1982 dissolved oxygen survey (Table 4.7). A slight degree of supersaturation was observed at the Michigan Avenue Bridge station on June 2, 1982. The absence of observations of undesireable algae is also evidence that eutrophication is not a serious problem on the Buffalo River.

9. Restrictions on Drinking Water Consumption or Taste and Odor Problems

Impairment status: No

The Buffalo River is not currently used as a public water supply. With Lake Erie serving as a reliable source for the City of Buffalo, it is unlikely that the Buffalo

River would be needed for this purpose. If the Buffalo River were to be considered as a Class "A" drinking water supply source, it would contravene standards for coliform bacteria and probably would contravene standards for dissolved oxygen. (See Table 4.16, Footnote 2 for further discussion.)

10. Beach Closings

Impairment status: No.

There are no public bathing areas along the Buffalo River. Several factors would inhibit or prevent the development of swimming facilities on the Buffalo River. The continuation of commercial navigation, and the likely expansion of recreational boating, are both incompatible with the development of bathing beaches on most reaches of the lower river. The continued presence of industrial facilities, and the natural sediment load and associated turbidity carried by the river during and after storm events, would also interfere with swimming on the lower Buffalo River. Water quality problems, especially elevated coliform counts associated with combined sewer overflows, along with contamination of river bottom sediments with heavy metals and organic substances, would also be an obstacle to development of swimming areas on the Buffalo River.

As there are no swimming beaches in the area and factors such as natural turbidity and potential conflicts with commercial navigation and recreational boating activities could inhibit or prevent future development, no impairment of this use exists in the Buffalo River. (See Table 4.16, Footnote 2 for further discussion.)

11. Degradation of Aesthetics

Impairment status: No.

Undesireable water quality aesthetics may impair a variety of uses on and around the Buffalo River, including fishing, boating, hiking and walking, and development and use of residential, commercial, and recreational facilities. Aesthetics may be impaired by the presence of unsightly, deleterious, or malodorous materials in or around the water. In addition, the aesthetics of land areas adjacent to the river generally affect the aesthetics of the river environment.

Raw sewage was observed in a limited amount entering the Buffalo River during 1987, apparently as a result of combined sewer overflows during dry weather. These overflow observations have been inspected, the causes have been identified (plugged siphons, a broken weir and several direct household connections). Immediate corrective measures have been taken relative to the plugged siphons and broken weir. Remedial measures have been initiated to eliminate the direct connections.

Debris and suspended sediment associated with storm events on the watershed result in the intermittent passage of floatables such as tree limbs, leaves, etc., and discoloration of the water. A past problem of unsightly floating oil on the river has been brought under control through direct discharge limitations and plant shut downs.

Until recently, the primary land use adjacent to the lower Buffalo River has been industrial. The decline of local manufacturing industries has left a series of decaying abandoned buildings, junkyards, dumping areas, and deteriorating grain elevators on the banks of the river.

These shoreline blight areas both detract from the aesthetics of the Buffalo River, and serve as a potential source of floatable trash.

While unsightly conditions exist along the banks of the Buffalo River, and the river is naturally turbid, water quality related aesthetics is not a problem.

12. Added Costs to Agriculture or Industry

Impairment status: No.

The cost of maintaining the Buffalo River Improvement Corporation, which pumps cooling water to industrial users from Lake Erie, is a continuing obligation that grew out of water quality problems in the river. Currently, however, the water quality of the Buffalo River would not impose additional costs on new industry. Agriculture is not a use associated with the Buffalo River.

13. Degradation of Phytoplankton and Zooplankton Populations

Impairment status: No.

Zooplankton are microscopic aquatic animals which are unable to effectively swim against a current. Zooplankton play a major role in aquatic food webs. Schematically, phytoplankton (primary producers) are eaten by zooplankton (primary consumers) and the zooplankton are eaten by fish (secondary consumers). Thus, if plankton populations are degraded, beneficial uses dependent on higher levels of the food chain, such as fishing, may be adversely affected. Zooplankton may also feed on bacteria, suspended particulate matter, and other zooplankters. Zooplankton are vectors of nutrient flux in the aquatic environment.

In 1961 and 1962, Blum conducted a survey of the biota of the Buffalo River. The only zooplankton he found was a cladoceran.

Frederick in 1978 noted that the water in the Buffalo River should support a diverse zooplankton population since adequate nutrients are present in the water for growth and reproduction. In 1979, Frederick and Booth noted that the sampling of three stations in the Buffalo River revealed the presence of a well developed zooplankton population.

In 1979, a quantitative and qualitative investigation of the crustacean zooplankton found in the Buffalo River was undertaken by Ward. The material presented is based upon Ward's report.

Various physical, chemical and biological parameters which may have an effect on zooplankton populations were measured. Those parameters included temperature, dissolved oxygen, light transmission, pH, transparency, specific conductance, total residue, chlorophyll a (an algal biomass estimator) and aerobic heterotrophs (organisms which obtain nourishment from organic matter).

Samples were collected each month from May through October 1979 by Ward at six stations along the lower 5.5 miles of the Buffalo River. The above parameters as well as zooplankton were measured at surface, mid and bottom depths at each station. Vertical zooplankton hauls were also taken at each station.

Ward reported extensive colonization of the Buffalo River by crustaecan zooplankton. Many more species were present than had previously been reported. The similarity in zooplankton communities which the Buffalo River shares with the Buffalo Harbor was striking. Ward stated that this similarity may be due in part to improved water quality.

Since 1967, the Buffalo River Improvement Corporation has been pumping Buffalo Harbor water to the member industries along the Buffalo River. Once it is used as a coolant, the water is returned to the river. It is unknown whether viable zooplankton could survive the heating of the water at the various industries and enter the river. (Many studies at power plants have indicated that if the water temperature changes more than 10-15^{O}F or exceeds 90^{O}F, zooplankton probably would not survive.)

Chlorophyll a was the only parameter analyzed by Ward in sufficient detail to assess phytoplankton populations. It appears that phytoplankton growth is light-limited (due to excessive silt and turbidity). It appears that phytoplankton are not impaired, as chlorophyll levels are moderate.

As with the phytoplankton, turbidity and high flow adversely influence zooplankton communities, though these factors may limit, but not impair, planktonic populations.

Zooplankton found in the Buffalo River generally indicate that the river is between mesotrophic and eutrophic in productive status. Trophic status in this sense would be based on the ratio of Cladocera and Cyclopoida to the Calanoida. Throughout the 1979 sampling, this ratio changed little and remained favorable to the Cladocera and Cyclopoida. The crustacean zooplankton community of the Buffalo River for 1979 was represented by 21 species of Cladocera and 14 species of Copedoda. Seasonal variations of zooplankton occurred. Littoral to limnetic species gradients from upstream to downstream were observed. Significantly greater total numbers occurred at the mid-depth and bottom-depth samples than in the surface samples. This difference may be a result of surface disturbance from sampling, but the difference may indicate a zooplankton preference for the availability of nutrients or the lower light intensity found at lower depths. Many of the species found in the Buffalo River were also found in the Buffalo Harbor and Lake Erie, indicating improved water quality in the river.

Ward noted that the ratio of Cladocera to Copepods was representative of a moderately to highly productive system. Waters with this level of productivity would not suffer impairment of zooplankton.

There appears to be a significant number of smaller plankters present. Bosmina, the most frequently found cladocera, are usually much smaller than Daphnia and other cladocera present in this stretch of the river. Among the Copepods, Copepod nauplii, the small, free-swimming larvae hatched from the copepod eggs, are much more numerous than any of the cyclopoid. This may be indicative of size-dependent predation (by fish) which often occurs when predation is moderate-to-intense. The dominance of smaller cladocerans is also a characteristic of some mesotrophic-to-eutrophic waters, since large numbers and sizes of algae may interfere with food collection of larger cladocerans. Therefore, it would appear that the zooplankton size ratios also lend credence to the conclusion that this particular stretch of the Buffalo River is moderately productive without significant impairment of zooplankton.

Using Ward's calculations of diversity and redundancy, it appears that for most stations at most times in this river stretch, diversity is high and redundancy is low, especially late in the summer. The number of genera present and the overall numbers of zooplankters in 1979 were much higher than in previously studied years, and appear to be within the same magnitude as numbers reported for other large rivers.

Degradation of phytoplankton and zooplankton is not a problem in the Buffalo River.

14. <u>Loss of Fish and Wildlife Habitat</u>

Impairment status: Yes.

Habitat loss impairs beneficial uses such as fishing, observing wild birds and animals, and educating students and other people about the natural environment of the region. The lower Buffalo River is heavily bulkheaded to facilitate docking, loading, and unloading activities associated with commercial water transport. The river is dredged, usually annually, to maintain a 22 foot water depth below low lake level datum for lake vessels. These activities, which have been going on since the 1800's, have resulted in major modifications of the natural habitat of the Buffalo River.

The combination of dredging and bulkheading has substantially reduced fish habitat by eliminating many productive shallow waters and wetlands. Vegetated banks are lacking in many areas. The productive shallows provide spawning and nursery areas for a wide variety of fish species, and thereby contribute to fish populations both in the river and in other areas to which the fish might migrate. Wetlands also provide food and shelter for wildlife such as migratory waterfowl and muskrats.

In addition to the loss of shallow water habitat, the Buffalo River suffers from a lack of rooted aquatic vegetation. This also limits the development of prosperous fish and wildlife populations. With the decline of industry and shipping on the Buffalo River, it may be feasible to restore some of the fish and wildlife habitat previously lost to dredging and bulkheading.

Impairment Summary

The status of each potential impairment or impairment indicator related to the Buffalo River is summarized in Table 4.16. For each impairment the likely causes are listed. Known impairments are restrictions on fish and wildlife consumption, fish tumors and other deformities, degradation of benthos, restriction on dredging activities and loss of fish and wildlife habitat. Impairments which existing evidence suggests are likely include tainting of fish and wildlife, degradation of fish and wildlife populations and bird or animal deformities or reproduction.

The likely causes of the noted impairments include the chemical substances: PCBs, chlordane, PAHs, DDT and metabolites, metals, cyanides and low dissolved oxygen, plus physical disturbances.

TABLE 4.16

SUMMARY OF IMPAIRMENTS AND IMPAIRMENT INDICATORS OF BENEFICIAL USES OF THE BUFFALO RIVER

No.	Impairments and Impairment Indicators	Impairment	Likely Causes
1.	Restrictions on fish and wildlife consumption	Yes	PCBs, chlordane
2.	Tainting of fish and wildlife flavor	Likely	PAHs
3.	Degradation of fish and wildlife populations	Likely 1/	Dissolved oxygen (Surrogate for organic matter)
4.	Fish tumors and other deformities	Yes	PAHs
5.	Bird or animal deformities or reproduction	Likely	PCBs, DDT and metabolites
6.	Degradation of benthos	Yes	None identified
7.	Restriction on dredging activities	Yes	Arsenic, barium, copper, iron, lead, manganese, zinc, cyanide

TABLE 4.16 (CON'T)

No.	Impairments and Impairment Indicators	Impairment	Likely Causes
8.	Eutrophication or undesireable algae	No	Not applicable
9.	Restrictions on drinking water consumption or taste and odor problems	No [2]	Not applicable
10.	Beach closings	No [2]	Not applicable
11.	Degradation of aesthetics	No [3]	Not applicable
12.	Added costs to agriculture or industry	No	Not applicable
13.	Degradation of phytoplankton and zoo-plankton population	No	Not applicable
14.	Loss of fish and wildlife habitat	Yes	Physical disturbance

See following page for footnotes

Footnotes (Table 4.16)

1/ River channelization is also a potential factor.

2/ While not a current use the BRCC believes that drinking water and swimming uses for the river are an impaired use under the Great Lakes Water Quality Agreement objectives. Currently the river is not classified at a level to provide drinking water or swimming use. The BRCC believes that aside from natural conditions, current pollution levels and sediment contamination would themselves prohibit these uses. The BRCC believes the goal of the RAP should be to restore the river to a water quality which would support drinking water and swimming uses if so desired in the future. This would insure that the policy of the Great Lakes Water Quality Agreement [particularly "the discharge of toxic substances in toxic amounts be prohibited and the discharge of any or all persistent toxic substances be virtually eliminated"] can be achieved. Drinking water consumption is not a current use of the river, and the public process DEC undertook recently in developing its Water Resources Management Strategy indicated there is not likely to be a future demand for use of the river as a drinking water supply. There are no swimming beaches in the area, and it is unlikely that these will be considered in the future because of natural turbidity. There have been reports indicating that local residents occasionally use the river for swimming, and this type of unpermitted usage may increase as water and sediment quality improve. DEC believes that the Great Lakes Water Quality Agreement policy is currently being carried out through existing programs (see Chapter 3) and that identification of 9 and 10 as impaired based on the BRCC reasoning would be inconsistent with the concept of best use that is basic to the New York State stream classification system. (See discussion of stream classification system in Chapter 3).

3/ Debris (tree limbs, leaves, etc.) passage, water discoloration and turbidity are associated with storm events on the watershed. The BRCC believes that the aesthetic quality of the water is degraded on an ongoing basis. While unsightly conditions exist along the banks of the river, and the river is naturally turbid, evidence available to DEC suggests that water quality related aesthetics in the river is not a problem.

CHAPTER 5
SOURCES

Introduction

There is a number of potential sources of contaminants which may cause or contribute to one or more use impairments. A general overview of potential sources, their location and characteristics is summarized in this Chapter. The source categories described have the greatest potential to be the origin of contaminants identified in the previous Chapter as likely causes of impairments.

Specific pollutants or disturbances known or suspected of causing impairment are then discussed in this Chapter along with data on potential sources. These causes include the chemical substances: polychlorinated biphenyls, chlordane, polynuclear aromatic hydrocarbons, DDT and metabolites, metals, cyanides and low dissolved oxygen, plus physical disturbances.

General Overview of Pollutant Sources

Wastewater Facility Discharges

Through the 1970's and early 1980's five major industrial facilities discharged to the Buffalo River. These facilities were: Allied Chemical Corporation - Industrial Chemicals Division; Allied Chemical Corporation-Speciality Chemicals Division; Donner-Hanna Coke; Mobil Oil Corporation and Republic Steel Corporation.

Three of these (Donner-Hanna Coke, Mobil Oil and Republic Steel) have terminated production. Substantial operational and ownership changes have taken place at the remaining two facilities. A summary of the changes follows.

Allied Chemical Corporation - Industrial Chemicals Division. In the late 1970's this firm produced sulfuric acid, sulfur trioxide, oleum, nitric acid, oxalic acid, ammonium thiosulfate, potassium nitrite and heavy metal nitrates. Process and cooling water were supplied by the Buffalo River Improvement Corporation (BRIC) at the rate of about 15 million gallons per day (mgd). In December 1980, the firm discontinued all nitrite and nitrate compound production operations. In October 1981, the sulfuric acid, sulfur trioxide and oleum production facilities were sold to PVS Chemical Corporation. In November 1982, all chemical production was discontinued by Allied Chemical Corporation except ammonium thiosulfate which was terminated in September 1985.

The current discharge consists of 10 mgd of non-contact cooling water from the PVS Chemical Corporation production of sulfuric acid, sulfur trioxide and oleum.

Allied Chemical Corporation, Speciality Chemicals Division. In 1970, Allied made as many as 1800 dye related products. Process and cooling water was supplied by BRIC at the rate of about 22 mgd. In 1971 a pretreatment facilty for process wastewater was completed and these flows were diverted from the Buffalo River to the Buffalo Sewer Authority (BSA) system. In 1977, the dye plant was sold to Buffalo Color Corporation. Dye products were reduced to about 100 at that time. Buffalo Color further reduced the product line, dropping most food, drug and cosmetic dyes in 1981. In 1985 indigo became the only dye product produced. The company currently produces 8 chemical products. Cooling water requirements decreased as products were eliminated.

Current discharges average about 11 mgd of non-contact cooling water. All process water is pretreated and discharged to the Buffalo Sewer Authority system.

Donner-Hanna Coke. In the 1970's through the early 1980's Donner-Hanna Coke produced metallurgical coke. The firm discharged BRIC-supplied process water and cooling water to the Buffalo River at approximately 16 mgd. Phenol recovery equipment was used to treat the discharge through December 1975, when sedimentation facilities were added.

In May 1982, coke production operations were terminated by this firm.

Mobil Oil. In the 1970's and into the early 1980's Mobil Oil operated a 43,000 barrel per day refinery adjacent to the Buffalo River. The water used in the refinery process during this period was supplied by the Buffalo River Improvement Corporation and consisted of about 21 mgd of which 1.6 mgd was used in the refining process and the remainder was used as once-through non-contact cooling water. The process water discharge, which was treated in an oil-water separator, was redirected from the Buffalo River to the Buffalo Sewer Authority system in November 1979. In May 1981, the firm ceased refinery operations. The facility has since functioned as a storage terminal. There is no current discharge from this facility to the Buffalo River.

Republic Steel Corporation. This firm was a basic producer of iron and steel products. Its discharge to the Buffalo River in the 1970's and early 1980's consisted of BRIC-supplied non-contact cooling water at about 35 mgd and process water at 13 mgd. In 1979 the firm undertook a program to eliminate a series of process water discharges and to construct a new wastewater treatment facility which was completed in 1980. Production operations at this site were terminated in mid-1981.

In addition to the major industrial facility changes discussed above, the Buffalo Sewer Authority in 1981 completed the construction of the Kelly Island sewer project which allowed the connection of 15 industrial facilities to the Buffalo Sewer Authority system which previously discharged to the Buffalo River. The majority of these firms were associated with the food processing and grain milling industry.

Sewage facilities serving urban areas in the towns immediately upstream of the City of Buffalo (Cheektowaga, Lancaster and West Seneca) were tied into the Buffalo Sewer Authority system through trunk lines completed by Erie County in 1977. The only other significant municipal discharger on the Buffalo River watershed, the Village of East Aurora, has provided secondary treatment since the 1920's. This plant was recently upgraded.

While the lower Buffalo River watershed is served by the Buffalo Sewer Authority (BSA) system the Authority's wastewater treatment plant discharge is to the Niagara River. The BSA regulates over 174 Significant Industrial Users to its system within the City of Buffalo and adjacent service area.

Currently there are seven municipal wastewater treatment facility discharges (Table 5.1) and thirteen industrial wastewater facility discharges (Table 5.2) in the Buffalo River watershed and area of concern (Figures 5.1 and 5.2). One municipal and two industrial facilities have discharges in excess of 0.5 mgd (million gallons per day). Based on flow the remaining facilities are considered minor discharges. The flow at each facility shown in Tables 5.1 and 5.2 is the 1986-87 average annual flow in million gallons per day (mgd).

Other wastewater discharges to the Buffalo River watershed include treated flows from small on-lot

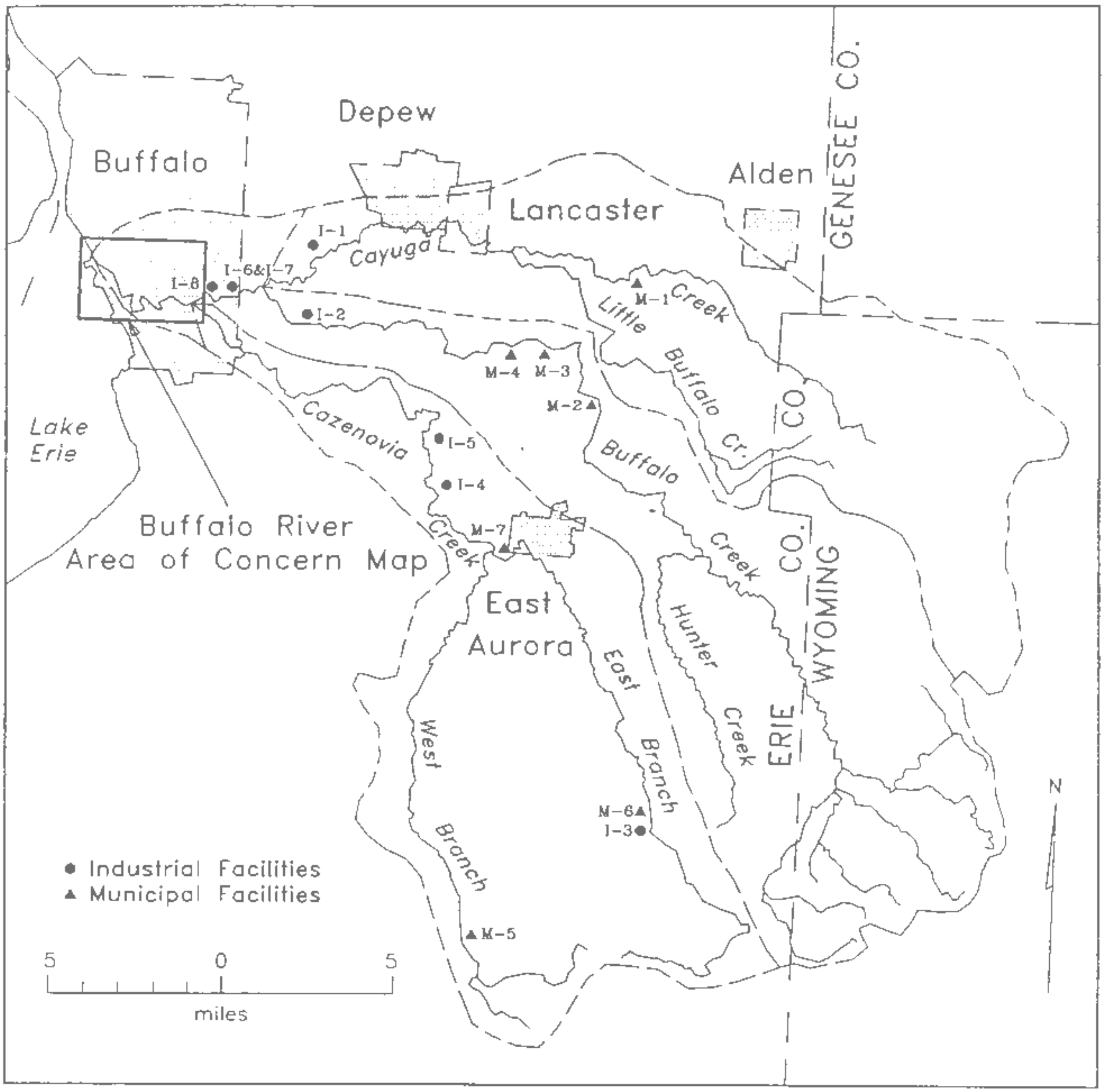


Figure 5.1 Location of Industrial and Municipal Wastewater Treatment Facility Discharges in the Buffalo River Watershed.

(See Tables 5.1 and 5.2 for site identification)

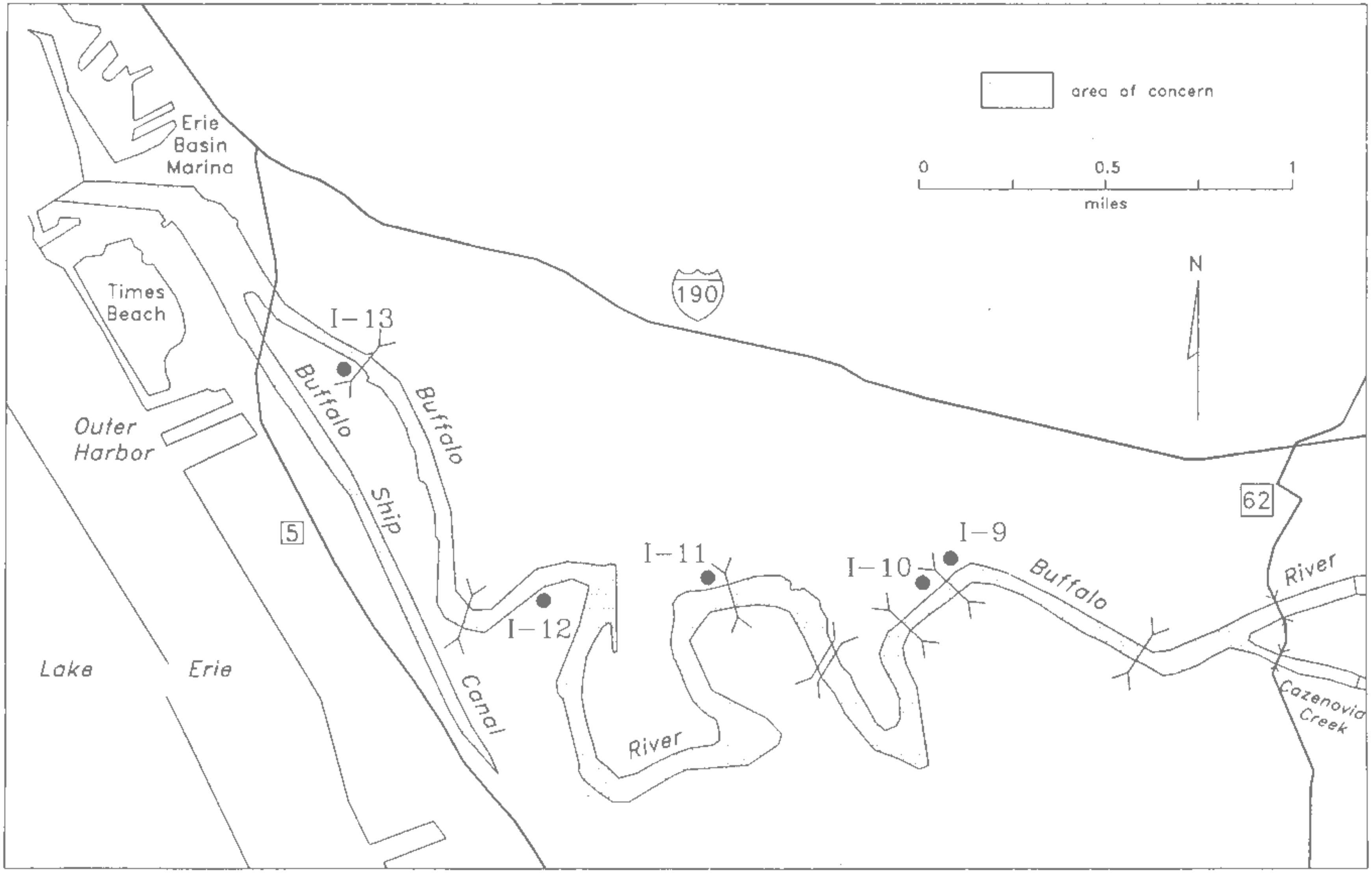


Figure 5.2 Location of Industrial Wastewater Facility Discharges in the Buffalo River Area of Concern

(See Table 5.2 for site identification)

TABLE 5.1
MUNICIPAL WASTEWATER TREATMENT FACILITY DISCHARGERS
BUFFALO RIVER WATERSHED

Map Reference	Stream & Facility	Flow (mgd)	Population Served	Treatment	Priority Pollutants 1/
	Cayuga Creek				
M 1	Alden (T) SD #2 WWTP	0.013	230	Secondary 5/	None Anticipated 2/
	Buffalo Creek				
M 2	Elma (T) SD #5 WWTP	0.051	350	Secondary 5/	None Anticipated 2/
M 3	Elma (T) SD #1 WWTP	0.014	130	Secondary 5/	None Anticipated 2/
M 4	Elma (T) SD #4 WWTP	0.010	180	Secondary 5/	None Anticipated 2/
	Cazenovia Creek 7/				
M 5	Concord (T) SD #1 WWTP	0.023	700	Secondary 5/	None Anticipated 2/
M 6	Erie County SD #3 Holland (T) WWTP	0.066	1,400	Secondary 5/	None Anticipated 2/
M 7	East Aurora (V) WWTP	1.81	9,200	Advanced 6/ Wastewater	None 3/
	Buffalo River				
	None 7/				
	Buffalo Ship Canal				
	None				

1/ Above 0.1 lb/day based on DEC sampling
2/ No priority pollutants above 0.1 lb/day anticipated based on nature of discharge
3/ Facility sampled for priority pollutants, none found above 0.1 lb/day
4/ Facility sampled for priority pollutants, see text for values above 0.1 lb/day
5/ Gravitational settling, activated sludge and chlorination
6/ Gravitational settling, activated sludge, nitrification, phosphorus removal, sand filtration
7/ Combined sewer overflows are discharged to this reach during storm events

TABLE 5.2
INDUSTRIAL WASTEWATER FACILITY DISCHARGERS
BUFFALO RIVER WATERSHED

Map Reference	Stream & Facility	Flow (mgd)	Manufacturing Classification	Discharge Type	Priority Pollutants 1/
	Cayuga Creek				
I 1	Joy Manufacturing Co.	0.03	Manufacturing of Air Compressors	Non-contact Cooling water	None 3/
	Buffalo Creek				
I 2	National Starch & Chem. Corp.	0.002	Manufacturing of Adhesives and Sealants	Non-contact Cooling Water	None Anticipated 1/
	Cazenovia Creek				
I 3	Fisher Price	0.030	Toy Manufacturer	Cooling Water	None Anticipated 1/
I 4	Seneca Platers	0.0005	Electroplater	Sanitary & Process Waters	None 3/
I 5	Moog, Inc.	0.10	Control Systems for Air & Space Vehicles	Sanitary, Process and Cooling Water	None 3/

1/ Above 0.1 lb/day based on DEC sampling

2/ No priority pollutants above 0.1 lb/day anticipated based on nature of discharge

3/ Facility sampled for priority pollutants, none found above 0.1 lb/day

TABLE 5.2 (cont'd)
INDUSTRIAL WASTEWATER FACILITY DISCHARGERS
BUFFALO RIVER WATERSHED

Map Reference	Stream & Facility	Flow (mgd)	Manufacturing Classification	Discharge Type	Priority Pollutants [1/]
	Buffalo River				
I 6	Consolidated Rail Corp. Frontier Yard	0.08	Railroad Switching Yard	Stormwater Runoff	None Anticipated [1/]
I 7	Consolidated Rail Corp. Bison Yard	0.21	Railroad Switching Yard	Stormwater Runoff	None Anticipated [1/]
I 8	Worthington Compressors, Inc.	0.125	Manufacturing of Industrial Compressors	Non-contact Cooling water	None [3/]
I 9	PVS Chemical, Inc.	10.0	Manufacturing of Sulfuric Acid	Non-contact Cooling water	Yes [4/]
I 10	Buffalo Color Corp.	10.0	Manufacturing of Organic Chemicals	Non-contact Cooling water	Yes [4/]
I 11	Airco Industrial Gases	0.085	Manufacutring of Industrial gases	Non-contact Cooling Water	None [3/]
I 12	Fred Koch Brewery	0.266	Processing of Barley into Malt	Non-contact Cooling Water	None Anticipated [1/]
I 13	General Mills	0.10	Cereal Grain Processing	Non-contact Cooling Water	None Anticipated [1/]
	Buffalo Ship Canal				
	None				

1/ Above 0.1 lb/day based on DEC sampling
2/ No priority pollutants above 0.1 lb/day anticipated based on nature of discharge
3/ Facility sampled for priority pollutants, none found above 0.1 lb/day
4/ Facility sampled for priority pollutants, see text for values above 0.1 lb/day

residential and commercial wastewater facilities in the non-urban areas and intermittent storm event related, urban collection system overflows.

The municipal and industrial facilities in Tables 5.1 and 5.2 are grouped by: tributaries of the Buffalo River, the Buffalo River and the Buffalo Ship Canal. Priority and other pollutants are noted at levels of 0.1 lb/day or greater. A concentration of 1 ug/l in a flow of 10 mgd is approximately 0.1 lb/day. DEC sampling data from 1985-86 and 1986-87 were used to identify the presence of pollutants. The facilities with priority pollutants in the discharge above 0.1 lb/day were Buffalo Color and PVS Chemical (Table 5.3).

Current municipal and industrial wastewater treatment facility discharges are not significant sources of priority pollutants to the Buffalo River.

Inactive Hazardous Waste Sites

There are 32 currently listed inactive hazardous waste disposal sites in the Buffalo River watershed (Figures 5.3 and 5.4).

Three inactive hazardous waste sites located south of Tifft Street (Alltift, Ramco and Republic Steel) are believed to drain to the outer harbor and would be included in the Niagara River RAP. Should further investigation indicate a discharge to the Buffalo River these sites would be ammended to the Buffalo River RAP.

The thirty-two sites are listed in Table 5.4 and are grouped by; tributaries of the Buffalo River, the Buffalo River and the Buffalo Ship Canal. The current remedial status of each site is presented in Table 5.5.

TABLE 5.3
MUNICIPAL AND INDUSTRIAL FACILITIES
PRIORITY POLLUTANTS ABOVE 0.1 LB/DAY
(lb/day)

Facility	Parameter	DEC Sampling 1/ 1985-86	1986-87
Buffalo Color			
	chloroform	0.0	3.0
	cyanide	0.5	0.0
	lead	0.0	0.5
	nickel	0.4	0.0
	zinc	0.8	1.7
PVS Chemical			
	N-nitrosodiphenylamine	0.0	0.2
	methylene chloride	0.0	1.7
	chromium	1.5	0.0
	copper	0.9	0.0
	zinc	5.4	0.0
	phenols (4AAP)	0.0	1.4

1/ One-24 hour annual composite

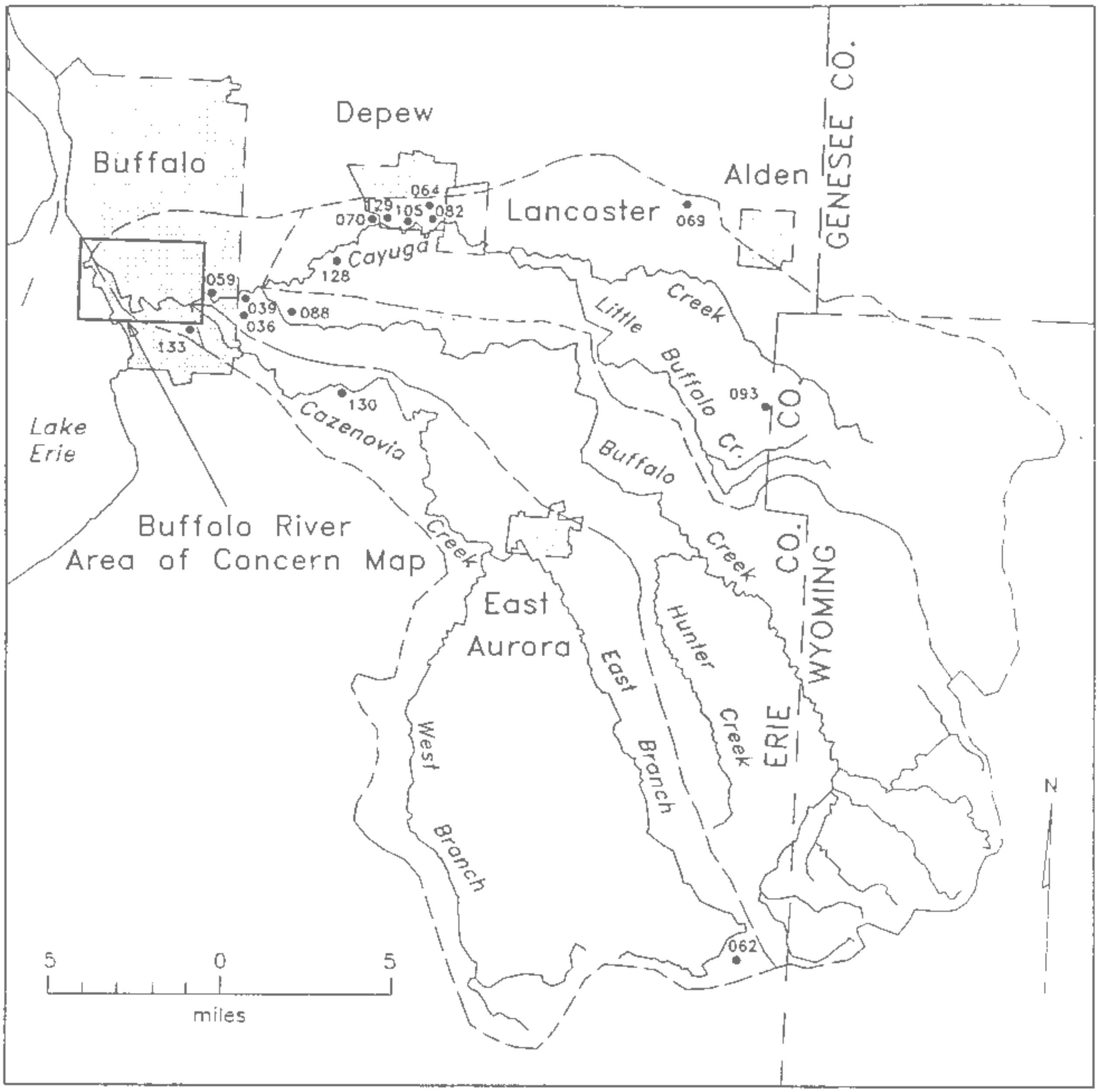


Figure 5.3 Location of Inactive Hazardous Waste Sites in the Buffalo River Watershed

(See Table 5.4 for site identification - last three digits of site number.)

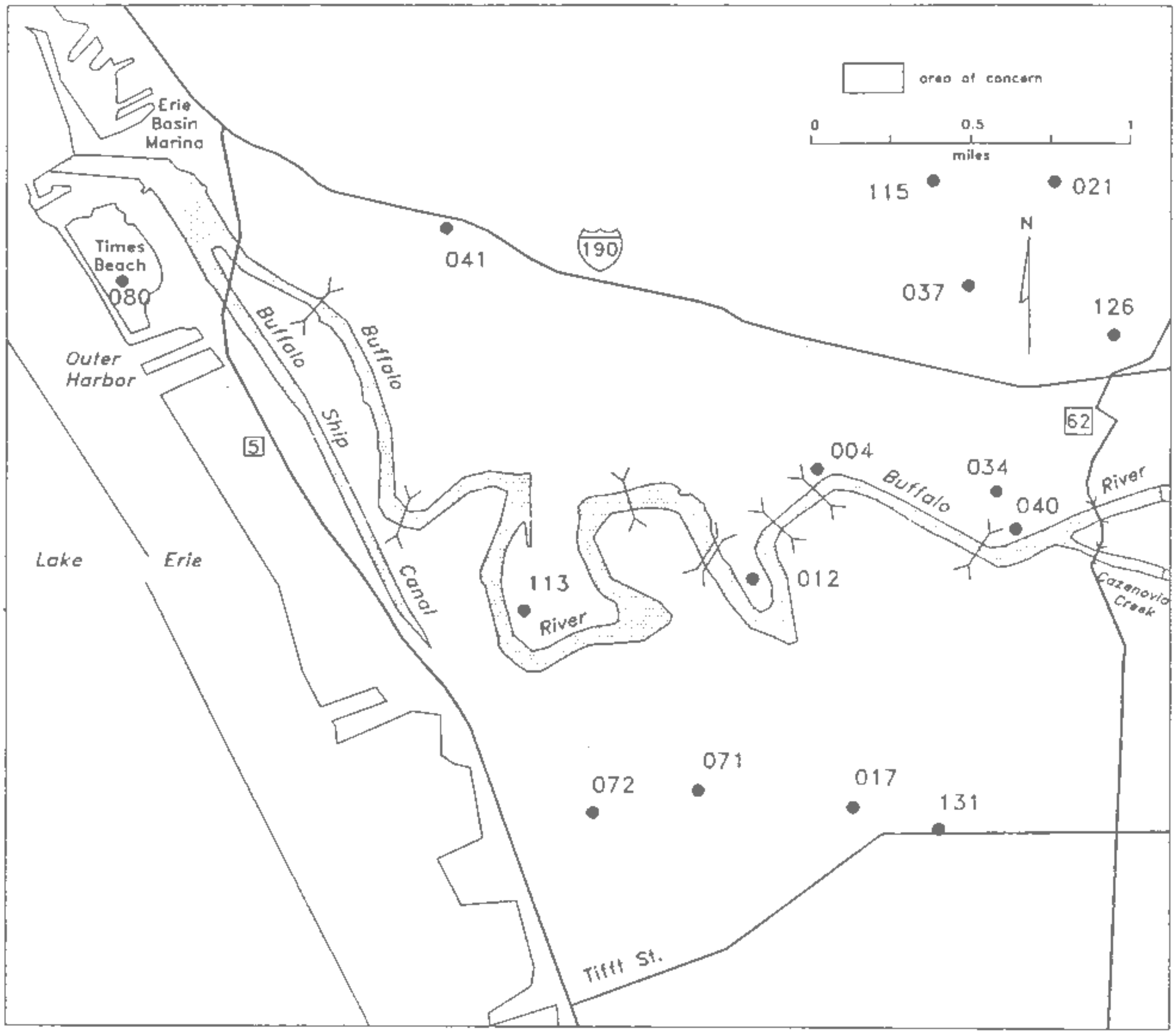


Figure 5.4 Location of Inactive Hazardous Waste Sites in the Buffalo River Area of Concern

(See Table 5.4 for site identification - last three digits of site number)

TABLE 5.4
HAZARDOUS WASTE SITES
BUFFALO RIVER WATERSHED

SITE NUMBER	SITE NAME	SITE CODE	YEARS IN OPERATION	SITE SIZE	CONTENTS	DISTANCE TO SURFACE WATER COURSE
CAYUGA CREEK						
915093	Town of Marilla	2A	1969-present	10 acres	unknown	Approx. 4000 ft. from Little Buffalo Creek.
915069	Lancaster Reclamation	2A	1976-1985	13 acres	Bentonite clay slurry, foundry sand, asbestos and glass fiber slurry, surface print wastes, prepaste polymer and alkali	Approx. 1000 ft from tributary of Plum Bottom Creek.
915082	Stocks Pond	2A	1961-1977	1.5 ac.	lube oil, brick, bentonite clay, sludge, foundry sand, etc.	Approx. 50 ft. from Cayuga Creek
915064	Dresser Industries	2A	unkn-1986	16 acres	foundry sand w/phenolics, slag, bentonite clay sludge, lube oil	Approx. 2000 ft from Cayuga Creek
915105	Village of Depew Borden Road	2A	1940-1962	5 acres	unknown, foundry sand used as cover material	Approx. 50 ft from Cayuga Creek
915070	Land Reclamation	3	1965-1983	100 acres	foundry sands, pine tar pitch, inks, lab chemicals, waste colors, acids	Less than 50 ft from Cayuga Creek
915129	Old Land Reclamation	2A	between 1958-1960 to 1978	64 acres	foundry sand, slag, flyash, oil sludge, inks, waste colors	Approx. 50 ft. from Cayuga Creek
915128	Union Road	2	unkn-1960	1 acre	tarlike material	Approx. 200 ft from Slate Bottom Creek

TABLE 5.4 (CON'T)

SITE NUMBER	SITE NAME	SITE CODE	YEARS IN OPERATION	SITE SIZE	CONTENTS	DISTANCE TO SURFACE WATER COURSE
BUFFALO CREEK						
915088	Northern Demolition	2A	1979-1980	1 acre	scrap metal and rubble from Buf. Color	Approx. 2000 ft to Buffalo Creek & about 1000 ft to a trib. to Bflo Creek
CAZENOVIA CREEK						
915062	CID (Chaffee)Landfill	4	1957-Present	51 acres	cyanide salts, solvents, PCB's (prior to 1965)	Approx. ½ mi. to a trib. to Cazenovia Creek
915130	Hi View Terrace	2A	unknown	1 acre	cyanide bearing wastes	Approx. 100 ft from Cazenovia Creek
BUFFALO RIVER						
915039	West Seneca Transfer Station	2A	1930s-1970	10 acres	incinerator ash	Approx. 200 ft from Buffalo River
915036	Madison Wire	2	unkn-1982	1 acre	heavy metals, cyanide	Adjacent to intermittent stream. Approx. 3800 ft. from Buffalo Riv
915059	Houghton Park	3	unkn-1973	15 acres	foundry sand w/phenolic binders	Approx. 100 ft. from Buffalo River
915021	Erie-Lackawanna Railroad	2A	unknown	NA	unknown	Approx. 5700 ft from Buffalo River
915040	Mobil Oil Corp.	3	1951-1976	3 acres	tetraethyl lead & lube sludges spent catalysts	Adjacent to Buffalo River

TABLE 5.4 (CON'T)

SITE NUMBER	SITE NAME	SITE CODE	YEARS IN OPERATION	SIZE	CONTENTS	DISTANCE TO SURFACE WATER COURSE
915037	Houdaille Ind. Manzel Division	2	unkn-1978	1	cutting oils, cooling compounds, benzene, solvents	Approx. 4000 ft from Buffalo River
915017	Donner Hanna Coke	3	1951-1975	20 acres	calcium carbonate, slag	Approx. 2000 ft from Buffalo River
915012A	Buffalo Color Corp.	2	1960-1976	1 acre	iron oxide sludge	Approx. 50 ft. from Buffalo River
915012B	Buffalo Color	2	1930-1976	1 acre	metal sludges	Adjacent to Buffalo River
915012C	Buffalo Color (Deep Well)	2	1957-1963	NA	40% ammonium sulfate solution	Not Applicable
915004	Allied Chemical Ind. Chem. Div. (PVS) Lee Street	2A	1930-1977	1 acre	spent vanadium pentoxide catalyst, sulfur sludges, salts of sulfuric and nitric acid, polymerized sulphan	Approx. 50 ft from Buffalo River
915071	Lehigh Valley Railroad	2A	unkn-unkn	20 acres	sludges, foundry sand	Approx. 500 ft from Buffalo River
915034	MacNaughton-Brooks	2A	1960-1966	1 acre	paint sludges, solvents, xylol, toluol	Approx. 800 ft. from Buffalo Riv.
915041	Mollenberg-Betz Machine	2A	unkn-1978	1 acre	waste oil and grease	Approx. 2000 ft from Buffalo Riv.
915072	Tifft Farm Nature Preserve	2A	1940's - 1973	260 ac.	incinerator ash & refuse from Squaw Island, flyash, pit sludge, foundry sand	Approx. 500 ft from Buffalo River
915115	Bengart & Memel, Inc.	4	1950-1978	1 acre	PCB contaminated oils	Approx. 5000 ft from Buffalo Riv.

TABLE 5.4 (CON'T)

SITE NUMBER	SITE NAME	SITE CODE	YEARS IN OPERATION	SITE SIZE	CONTENTS	DISTANCE TO SURFACE WATER COURSE
915126	Clinton-Bailey	2A	unkn-unkn	12 ac.	fill with elevated heavy metals	Approx. 3500 ft from Buffalo River
915113	U.S. Steel Eastern Division	2A	1917-1979	1 acre	waste oils, limestone sediment	Approx. 100 ft from Buffalo River
915131	Tifft - Hopkins St.	2A	unknown	2.3 ac.	Black granular material which contains chlorobenzene	Approx. 0.75 miles from Buffalo River
915133	Ameron	2	1960-1983	1 acre	Solvents such as xylene and methyl ethyl ketone	Approx. 1.25 miles from Buffalo River
ADJACENT TO MOUTH OF BUFFALO RIVER						
915080	Times Beach	2	1971-1976	30 acres	Dredge spoil from the Buffalo River, Blackrock Canal and Outer Harbor. Spoil contains various organic chemicals including PCB's, anilines, chlorobenzenes, and polynuclear aromatic hydrocarbons.	Adjacent to Outer Harbor and mouth of the Buffalo River.

915003B + 915-004

ALLIEDCHEM SPECIAL CHEMICAL DIV ALLIEDCHEM - INDUSTRIAL CHEM DIV

TABLE 5.5
REMEDIATION STATUS
HAZARDOUS WASTE SITES
BUFFALO RIVER WATERSHED

NUMBER	SITE NAME	SITE CODE	REMEDIATION STATUS	CONTAMINANT MIGRATION CONCERNS
CAYUGA CREEK				
915093	Town of Marilla	2A	Phase I investigation in draft form. Phase II investigation planned.	Leachate problems at the site and groundwater data indicate a potential for contaminant migration from this site.
915069	Lancaster Reclamation	2A	Phase I Investigation completed. Phase II Investigation scheduled.	Limited analyses of groundwater and surface water have shown presence of phenols. Potential for contaminant movement to the creek exists.
915082	Stocks Pond	2A	Phase I Investigation completed.	Proximity of this site to Cayuga Creek and slightly elevated levels of metals and phenols at site indicate a potential for contaminant movement to the creek.
915064	Dresser Industries	2A	Phase I investigation completed	Potential for contaminant migration indeterminable.
915105	Village of Depew - Borden Rd.	2A	Phase I investigation in draft form	The site contains foundy sands with phenolic based binders. A portion of the site has been excavated. Potential for contaminant migration indeterminable.
915070	Land Reclamation	3	Phase I Investigation complete Phase II Investigation scheduled	Data indicates presence of contaminants in groundwater and surface water. Contaminant migration confirmed.
915129	Old Land Reclamation	2A	Phase I Investigation complete. Phase II Investigation scheduled.	Soil and leachate sampling indicates the presence of inorganic and organic contaminants. Proximity of this site to Cayuga Creek indicates a potential for contaminant movement to the creek.

TABLE 5.5 (CON'T)

NUMBER	SITE NAME	SITE CODE	REMEDIATION STATUS	CONTAMINANT MIGRATION CONCERNS
915128	Union Road	2	Phase I investigation completed & RI/FS investigation is scheduled for 88/89	Site contains sludges and tar. Data indicates the presence of elevated levels of heavy metals in tar. Surface water and sediment sampling confirm the migration of lead from the site.
BUFFALO CREEK				
915088	Northern Demolition	2A	Phase I Investigation completed.	Data does not indicate potential for contaminant migration.
CAZENOVIA CREEK				
915062	CID (Chaffee Landfill)	4	Leachate collection system installed.	Data available indicates no contaminant migration.
915130	Hi View Terrace	2A	Phase I Investigation in final form	Data indicates presence of total cyanides in waste material. Storm sewer passes through waste providing a migration avenue. Potential for contaminant migration indicated.
BUFFALO RIVER				
915039	West Seneca Transfer Station	2A	Phase I Investigation completed. Phase II Investigation planned.	Potential for contaminant migration is indeterminable.
915036	Madison Wire - Indian Church Road	2	Phase I & II Investigations completed. RI/FS to be conducted in 1988. Removal action for drums & liquids completed by EPA	Soil, sediment and surface water samples show the presence of heavy metals and organics. Potential for contaminant migration is indicated.

TABLE 5.5 (CON'T)

NUMBER	SITE NAME	SITE CODE	REMEDIATION STATUS	CONTAMINANT MIGRATION CONCERNS
915059	Houghton Park	3	Phase I Investigation completed. Buffalo Urban Renewal Agency investigated site in 1983.	Analytical data shows contamination of soil and groundwater with heavy metals and phenols. However no significant contaminant migration indicated.
915021	Erie Lackawanna Railroad	2A	Phase I Investigation completed.	Potential for contaminant migration is indeterminable.
915040	Mobil Oil Corporation	3	Phase I Investigation completed. Phase II Investigation completed.	Investigation indicates no significant contaminant migration.
915037	Houdaille-Manzel	2	Negotiations for remediation Consent Order are underway	Site is contaminated with heavy metals and low levels of organic compounds. However off-site contamination migration is unlikely.
915017	Donner Hanna Coke	3	Phase I Investigation completed. Phase II Investigation planned.	Potential for contaminant migration is indeterminable.
915012(A,B)	Buffalo Color	2	Field investigation completed. Consent Order signed for RI/FS to be completed in 88/89	Site contains organic and inorganic contaminants. Migration of contaminants to Buffalo River is indicated.
915012C	Buffalo Color	2	Deep well has not been properly closed out	Potential for migration exists until well is closed out.
/915004	Allied Chemical Ind. Chem. Div.	2A	Phase II investigation underway	Low pH values found in monitoring wells could enhance mobilization and seepage of heavy metals to Buffalo River.
915071	Lehigh Valley Railroad	2A	Phase II Investigation is planned	Potential for contaminant migration is indeterminable.

TABLE 5.5 (CON'T)

NUMBER	SITE NAME	SITE CODE	REMEDIATION STATUS	CONTAMINANT MIGRATION CONCERNS
915034	MacNaughton-Brooks	2A	Phase II Investigation underway	Soil samples indicate the presence of heavy metals and paint related organic chemicals. Silt and sand underlying the site provides a potential for migration of chemicals to Buffalo River.
915041	Mollenberg-Betz	2A	Phase I Investigation completed	Phase I Investigation did not indicate potential for contaminant migration.
915072	Tifft Farm Nature Preserve	2A	Phase II Investigation in final form	Potential for contaminant migration is indeterminable.
915115	Bengart & Memel	4	Site has been remediated under Consent Order	PCB contaminated soils have been removed from the site.
915126	Clinton-Bailey	2A	Phase I Investigation completed. Niagara Frontier Transporatation Auth. also investigated the site.	Data indicates the presence of heavy metals (arsenic) and organic compounds in soil samples at site. Potential for contaminant migration indeterminable.
915113	U.S. Steel - Eastern Div.	2A	Phase I Investigation complete	Potential for contaminant migration is indeterminable.
915131	Tifft-Hopkins St.	2a	Phase I Investigation is underway	Potential for contaminant migration has not been determined yet.
915133	Ameron	2	Investigation by Ameron has been completed and remedial system is in operation.	Data does not indicate potential for contaminant migration.
ADJACENT TO MOUTH OF BUFFALO RIVER				
915080	Times Beach	2	Phase I Investigation complete. Corps of Engineers had undertaken sampling of surface and groundwater, sediment, flora and fauna.	Potential for contaminant movement to Outer Harbor exists.

Based on data presently available, the contaminant migration potential in groundwater for each of the sites can be summarized as follows:

- Potential for contaminant migration confirmed - 4 sites (Land Reclamation, Union Road, Buffalo Color (A), Buffalo Color (B))

- Potential for contaminant migration indicated - 11 sites (Lancaster Reclamation, Stocks Pond, Old Land Reclamation, Town of Marilla, Hi View Terrace, Madison Wire, Houghton Park, Buffalo Color (C), Allied Chemical, MacNaughton-Brooks, and Times Beach)

- Potential for contaminant migration not indicated - 7 sites (Northern Demolition, CID, Mobil Oil, Houdaille-Manzel, Ameron, Mollenberg-Betz, Bengart and Memel)

- Potential for contaminant migration currently indeterminable - 10 sites (Dresser, Village of Depew-Borden Road, West Seneca Transfer Station, Erie-Lackawanna Railroad, Donner-Hanna Coke, Tifft-Hopkins, Lehigh Valley Railroad, Tifft Farm, Clinton-Bailey and U.S. Steel)

Sewer System Overflows

Overflow retention facilities are operational or are being evaluated for sewer system overflows upstream of the Buffalo Sewer Authority (BSA) system. The BSA combined sewer system has 23 overflows to the Buffalo River and 16 overflows to lower Cazenovia Creek. (Figure 5.5)

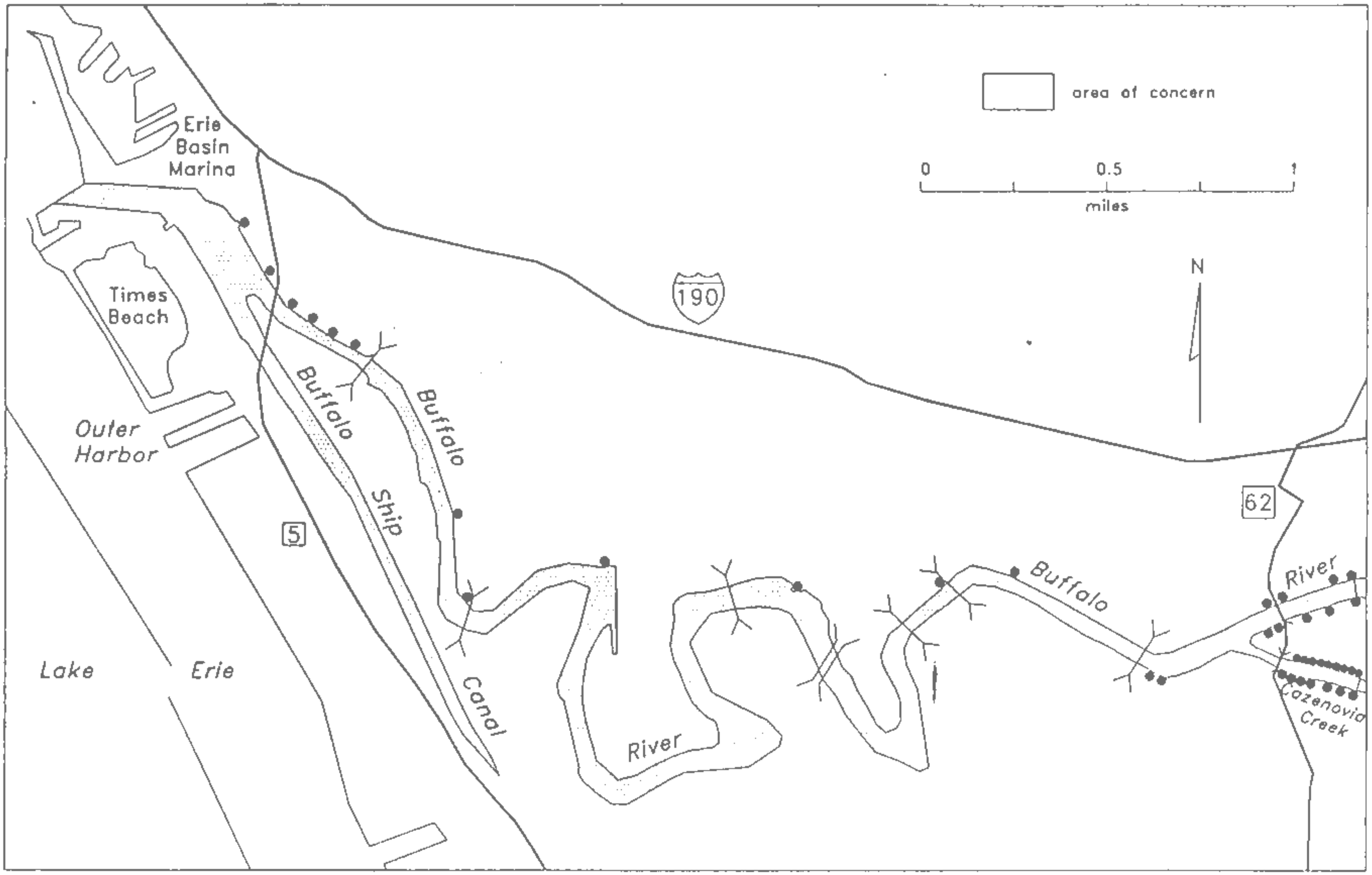


Figure 5.5 Location of Combined Sewer Overflows in the Buffalo River Area of Concern

Since the early 1980's, the BSA has been undertaking a sewer remediation program to upgrade the structural features of the system, a sewer cleaning program and an overflow structure backflow prevention program to improve system carrying capacity. A system modeling study is currently underway and will be completed in 1989 to evaluate the frequency and extent of overflows as well as assess options for their minimization.

Priority pollutant sampling data collected by the DEC of the influent flow to the BSA wastewater treatment facility from 1985 to 1987 is presented for both dry and wet weather conditions to characterize potential overflows from the collection system (Table 5.6).

Bottom Sediments

Sediments accumulate contaminants by attraction of chemicals out of the dissolved phase and onto solids. The presence of sediments indicates that an area is a deposition zone but not all deposition zones are stable. Unusually intense storms or other rare hydrological events can remobilize riverine sediments and send them off to other places. Contaminants on sediments may also find their way into bottom feeding organisms where they may cause toxic effects or bioaccumulate to the point of threatening higher food chain consumers. While these effects are real and a subject of concern there are problems in evaluating sediment contaminant concentrations. Where the sources of toxic discharge are curtailed and sediment stability is high, sedimentation itself will gradually bury noxious substances so they will be non-bioavailable. Where dredging or other expected disturbances are likely or surface concentrations are high enough to have adverse effects remedial action becomes necessary. Technically sound remedial actions

TABLE 5.6

PRIORITY POLLUTANTS AND OTHER PARAMETERS IN INFLUENT TO [1]
BUFFALO SEWER AUTHORITY WASTEWATER TREATMENT PLANT
DEC SAMPLING 1985-1987
(ug/l)

PARAMETER	OCT 15-16 1985	OCT 16-17 1985	OCT 17-18 1985	SEPT 17-18 1986	MAR 19-20 1987	JUNE 2-3 1987	SEPT 17-18 1987
FLOW (mgd)	150.78	119.77	120.71	109.23	117.92	438.6	217.7
ACID EXTRACTABLES							
phenol	93	4.5					
BASE/NEUTRALS							
aniline				160			
bis(2-ethylhexyl) phthalate	4.7					8	16
diethylphthalate						2	2
di-n-butylphthalate						2	
di-n-octylphthalate							8
naphthalene	1.9	2.1	3.2				2
phenanthrene					11		1
PESTICIDES							
BHC, gamma	0.032	0.052					
4,4' DDT	0.10						
endrin		0.077					
PURGABLES							
acetone				140			
benzene						4	
2-butanone							
chlorobenzene							2
chloroform	4.2	6.8	5		5		2
1,2-dichlorobenzene		2.7					
1,4-dichlorobenzene			23			2	
1,1-dichloroethylene							2
1,2-dichloroethane		3.5					
trans 1,2-dichloroethylene		2					
ethylbenzene						5	2
methylene chloride	13	15	29	15	7	3	
tetrachloroethene	17	23	14	19	4		12
toluene	9.8	30	7.6	10	9	41	110
1,1,1-trichloroethane	6.6	13	6.2	61	18		
trichloroethene	8.8	3	3	65			3
xylenes				17	13		
METALS & CYANIDE							
chromium	42	54		20	16		29
copper	94	132	128	78	65	38	
lead	17	18	14	19	20	67	38
mercury						0.4	
nickel	43	60	38		46	20	43
silver	8	16	21				24
thallium		8					
zinc	389	241	262	189	169	278	234
cyanide	16	14	11			10	
OTHERS							
phenols (4AAP)	93	92	30	38	48	100	22

[1] Priority Pollutants not listed were not detected
Blank = not detected

Detection limit ranges: acid extractables (0.5-25 ug/l)
base/neutral extractables (0.5-10 ug/l), pesticides (0.001-0.01 ug/l),
purgeables (0.5-10 uq/l), metals and cyanide (0.2-100 ug/l),
phenols (4AAP) (1-10 ug/l).

require knowing the areal and volumetric extent of sediments that cause impairments.

Evidence of contaminants in the bottom sediments of the Buffalo River is shown by sampling conducted by the U.S. Environmental Protection Agency - Region (V) and the U.S. Army Corps of Engineers - Buffalo District in 1981, DEC in 1983 and Erie County in 1985 (Tables A.3, A.4, A.5, and A.6, Appendix).

Sources of Pollutants and Disturbances Related to Short Term Goal

Based on the use impairment assessment of the Buffalo River the following pollutants: polychlorinated biphenyls, chlordane, polynuclear aromatic hydrocarbons, DDT and metabolites, metals, cyanides and low dissolved oxygen, plus physical disturbances, have been identified or are suspected of causing or contributing to one or more use impairments.

Polychlorinated Biphenyls

Impairment Observations. Polychlorinated biphenyls (PCBs) have been identified as exceeding the U.S. Food and Drug Administration (FDA) action level (2.0 ug/g) in carp taken from the Buffalo River in 1977, 1983 and 1984 (Table 4.4). Carp collected in 1980 contained detectable amounts of PCBs, however, they were not in excess of the 2.0 ug/g FDA action level. White suckers (collected in 1977), pumpkinseed (collected in 1983) and brown bullheads (collected in 1984) contained detectable PCBs but not in excess of the FDA action level. Spottail shiners (collected in 1984) showed PCBs in excess of the New York State Department of Environmental Conservation (DEC) criteria of 0.11 ug/g for the protection of fish eating wildlife (Table 4.9).

Sources. PCBs, which have a low solubility in water, have not been analyzed in the water column of the Buffalo River. PCBs have been observed in 12 out of 12 bottom sediment samples (median value 0.45 ug/g) collected by the U.S. Army Corps of Engineers - Buffalo District (COE) in 1981, in 15 out of 16 bottom sediment samples (median value 0.136 ug/g) collected by the U.S. Environmental Protection Agency - Region V (EPA) in 1981 and in 58 cores analyzed (median value 0.871) by Erie County in 1985.

A sediment criterion level of 0.03 ug/g has been calculated by the DEC (Division of Fish and Wildlife) based on the ambient water quality standard of 0.001 ug/l to protect wildlife from the toxic effects of eating contaminated fish, an octanol/water distribution coefficient for PCBs of 100,000 and an organic carbon level of 3 percent. This criterion indicates the median 1981 level of PCBs in Buffalo River sediments would be about 5 to 30 times greater than allowable. This same calculation with FDA action values would also indicate that PCB levels in bottom sediments would cause restrictions on human consumption of fish and wildlife. Experimentally validated bottom sediment criteria applicable to the Buffalo River need to be established.

There are no permitted discharges of PCBs from municipal and industrial treatment facilities to the Buffalo River.

PCBs have been detected at the following inactive hazardous waste sites in the Buffalo River watershed: Madison Wire, Bengart and Memel and Lancaster Reclamation. PCBs are also in the sediments contained in the Times Beach Confined Disposal Facility located in the Buffalo Harbor near the mouth of the Buffalo River.

Sampling conducted by the U.S. Army Corps of Engineers has revealed the presence of PCBs in the sediments contained at the Times Beach site. Samples of fish taken from the diked area at Times Beach have also shown elevated levels of PCBs. However, PCBs have not been detected in groundwater samples collected at the site.

Monitoring of the influent to the Buffalo Sewer Authority Wastewater Treatment Plant by DEC under both dry and wet weather conditions from 1985 through 1987 as an indicator of what might be present in periodic combined sewer overflows has not indicated the presence of PCBs.

Based on the criterion level calculated by DEC, bottom sediments would be a known source of PCBs likely to impact fish eating wildlife and cause restrictions on fish and wildlife consumption by humans. Due to the detection of PCBs in site samples, inactive hazardous waste sites are potential sources.

Chlordane

Impairment Observations. Chlordane, has been identified as exceeding the FDA action level (0.3 ug/g) in the carp sample taken from the Buffalo River in 1984 (Table 4.4). Carp collected in 1980 and 1983 contained detectable amounts of chlordane but did not exceed the FDA action level. Pumpkinseed (collected in 1983) and brown bullheads (collected in 1984) contained detectable amounts of chlordane but not in excess of the FDA action level. Spottail shiners (collected in 1985 and 1987) showed no detectable amounts of chlordane.

Sources. Chlordane, a pesticide banned in New York State since 1985, has not been analyzed in the water column of the Buffalo River. Chlordane was observed in 16 out of

16 bottom sediment samples (median value 0.01 ug/g) collected by EPA in 1981.

There are no permitted discharges of chlordane from municipal and industrial treatment facilities to the Buffalo River.

Chlordane has not been detected at any of the inactive hazardous waste sites in the Buffalo River watershed.

Monitoring of the influent to the Buffalo Sewer Authority Wastewater Treatment Plant during both dry and wet weather from 1985 to 1987 by DEC has not indicated the presence of chlordane.

Bottom sediments are the only potential source with analytical detections of chlordane. Criteria are required to assess the levels observed. Chlordane has only exceeded the FDA action level in one fish sample taken from the Buffalo River.

DDT and Metabolites

Impairment Observations. Total DDT (including its metabolites DDD and DDE) levels observed in carp from the Buffalo River in five samples analyzed from 1980 to 1984 exceeded the DEC criteria of 0.2 ug/g for the protection of fish eating wildlife. The criteria were also exceeded in white suckers (collected in 1977) and brown bullheads (collected in 1984). The criteria were not exceeded in two analyses of pumpkinseed (collected in 1983) or in analyses of spottail shiners (collected in 1985 and 1987). None of the values observed exceeded the FDA action level of 5.0 ug/g for the protection of human health.

Sources. DDT (and metabolites), a banned pesticide in New York State since 1971, was not observed in water column analyses of samples taken by DEC from the Buffalo River at Ohio Street. Total DDT was observed in 3 out of 12 bottom sediment samples collected by the COE in 1981 and in 15 out of 16 samples (median value 0.001 ug/g) collected by EPA in 1981. The median value of core samples analyzed by Erie County in 1985 was 0.008 ug/g.

There are no permitted discharges of DDT and its metabolites from municipal and industrial treatment facilities to the Buffalo River.

DDT and its metabolites have not been detected at any of the inactive hazardous waste sites in the Buffalo River watershed.

Monitoring of the influent to the Buffalo Sewer Authority Wastewater Treatment Plant during both dry and wet weather from 1985 to 1987 by DEC indicated the presence of DDT in only one out of seven samples at 0.1 ug/l.

DDT has been observed in 15 out of 16 sediment samples analyzed by EPA. Bottom sediments therefore would be the only potential source of this substance with a high frequency of detections.

Polynuclear Aromatic Hydrocarbons

Impairment Observations. PAHs, which are known carcinogens, are present in Buffalo River bottom sediments at levels that are elevated when compared with nearshore bottom sediments in Lake Erie near Buffalo.

Sources. PAHs were not observed in 1982-86 DEC water samples from the Buffalo River. However, they were observed in floating artificial substrate adsorber samples collected by DEC in 1981. The levels which have been observed in the Buffalo River bottom sediments are shown in Tables A.5 and A.6.

There are no permitted discharges of PAHs from municipal and industrial wastewater treatment facilities to the Buffalo River.

PAHs have been observed at the following inactive hazardous waste sites in the Buffalo River basin: Houghton Park, Mobil Oil, Buffalo Color, Donner-Hanna Coke and Tifft Farm. PAHs are also in the sediments contained in the Times Beach Confined Disposal Facility located in the Buffalo Harbor near the mouth of the Buffalo River.

The Houghton Park, Mobil Oil and Buffalo Color sites are all adjacent to the Buffalo River, while the Donner-Hanna site is about 1/2 mile from the river and the Tifft Farm site is about 500 feet distant.

Recently, estimates of contaminant loadings from the Buffalo Color, Mobil Oil and Times Beach sites have been prepared by consultants for EPA. Estimated loadings for total organic contaminants are presented below:

Site	Best Estimate (lb/day)
Buffalo Color	3.9
Mobil Oil	1.3
Times Beach	0.01

Monitoring of the influent to the Buffalo Sewer Authority Wastewater Treatment Plant from 1985 to 1987 by

DEC has indicated the presence of naphthalene (not detected to 3.2 ug/l) and phenanthrene (not detected to 11 ug/l).

Based on observations of PAHs in bottom feeding species during Buffalo River fish tumor studies, bottom sediments are considered a known source for fish tumors and tainting. Due to the detection of PAHs in site samples inactive hazardous waste sites are potential sources as well as combined sewer overflows.

Metals & Cyanides

Impairment Observations. The median values of the following metals and cyanides in Buffalo River bottom sediments exceed the criteria for open lake disposal based on 1981 sampling conducted by the COE and EPA and 1985 sampling by Erie County: arsenic, barium, copper, iron, lead, manganese, zinc and cyanides.

Sources. The frequency of observation and mean value of the above contaminants in the 1982-86 DEC water column data are indicated in Table 5.7. The above substances are limited in the discharges from industrial wastewater treatment facilities as shown in Table 5.8.

The above metal and cyanide contaminants have been observed in samples at the inactive hazardous waste disposal sites indicated in Table 5.9. In addition, these substances are present in the sediments contained in the Times Beach Confined Disposal Facility located in the Buffalo Harbor near the mouth of the Buffalo River.

Of those sites listed in Table 5.9, the following have potential to be sources of metals and cyanides to the river based on their location and available data: Land Reclamation, Old Land Reclamation, Union Road, Madison Wire,

TABLE 5.7
FREQUENCY OF OBSERVATIONS AND MEAN VALUES
IN BUFFALO RIVER
WATER OF METALS AND CYANIDES

Contaminant	Detection Limit (ug/l)	Frequency of Observations in Water Column	Mean Value (ug/l)
arsenic	30	0/27 1/	0.0
barium	NA 2/	NA	NA
copper	30	0/27	0.0
iron	NA	NA	NA
lead	30	2/27	9.1
manganese	NA	NA	NA
zinc	30	9/27	12.3
cyanides	NA	NA	NA

1/ Number of exceedances per number of samples

2/ Not analyzed

TABLE 5.8
MAXIMUM ALLOWABLE PERMITTED LOADING
INDUSTRIAL WASTEWATER FACILITY DISCHARGES
BUFFALO RIVER WATERSHED
METALS AND CYANIDES EXCEEDING
OPEN LAKE DISPOSAL CRITERIA IN BOTTOM SEDIMENTS

Parameter	Facility	Flow 1/ (mgd)	Max. Daily Permit Limit (mg/l)	Maximum Allowable Loading (lb/day)
arsenic	Seneca Platers	0.0005	0.05	0.0002
barium	None			
copper	Joy Manufacturing	0.03	0.2	0.05
	Seneca Platers	0.0005	1.0	0.004
iron	Seneca Platers	0.0005	0.6	0.003
lead	PVS Chemical	10.0	0.03	2.5
	Seneca Platers	0.0005	0.05	0.0002
manganese	Seneca Platers	0.0005	0.6	0.003
zinc	Joy Manufacturing	0.03	0.3	0.075
cyanides	Buffalo Color	10.0	0.056	4.7
	Seneca Platers	0.0005	0.4	0.002

1/ 1986-87 average annual daily flow

TABLE 5.9
INACTIVE HAZARDOUS WASTE SITES
IN THE BUFFALO RIVER BASIN
WHERE METALS AND CYANIDES HAVE BEEN OBSERVED
IN SITE MONITORING DATA

Site	Arsenic	Barium	Copper	Iron	Lead	Manganese	Zinc	Cyanide
CAYUGA CREEK								
Town of Marilla				x				x
Lancaster Reclamation					x		x	
Stocks Pond	x		x		x		x	
Land Reclamation				x	x	x		
Old Land Reclamation		x			x		x	
Union Road			x		x			
BUFFALO CREEK								
None								
CAZENOVIA CREEK								
CID (Chaffee) Landfill				x	x	x	x	x
HiView Terrace	x		x	x	x		x	x
BUFFALO RIVER								
West Sencea Transfer Station			x		x			
Madison Wire	x		x	x	x		x	x
Houghton Park	x		x		x		x	

TABLE 5.9 (Con't)

Site	Arsenic	Barium	Copper	Iron	Lead	Manganese	Zinc	Cyanide
BUFFALO RIVER (CONT.)								
Mobil Oil Corp.	x	x	x		x		x	
Houdaille Ind.-Manzel Div.					x			
Ameron		x	x	x	x	x	x	
Donner-Hanna Coke	x	x		x	x			x
Buffalo Color - A	x		x		x		x	
Buffalo Color - B	x		x		x		x	
Allied Chemical Ind. Chem Div. (PVS) Lee Street			x	x	x			
MacNaughton-Brooks				x	x			
Tifft Farm Nature Preserve			x	x	x			
Clinton-Bailey	x			x	x			

Buffalo Color and Allied Chemical - Industrial Chemical Division.

Recently, estimates of contaminant loading from the Buffalo Color, Allied Chemical and Times Beach sites have been prepared by consultants to EPA. Estimated loadings for total inorganic contaminants are presented below:

Site	Best Estimate (lbs/day)
Buffalo Color	0.5
Times Beach	0.081
Allied Chemical	0.02

Sufficient data do not exist at this time to assess the potential of the remaining sites on Table 5.9 as sources of metals or cyanides to the Buffalo River system.

Monitoring of the influent to the Buffalo Sewer Authority Wastewater Treatment Plant under both dry and wet weather conditions indicates the presence of copper (38 to 148 ug/l), lead (14 to 67 ug/l), zinc (169 to 389 ug/l) and cyanides (not detected to 16 ug/l). Barium, iron and manganese were not analyzed.

A summary of the flow weighted means of the 1987 DEC sampling data at three upstream tributary stations and the mean values at the Buffalo River Ohio Street station for the above parameters is presented in Table 5.10.

These data indicate an overall approximate doubling of the parameter concentrations from the upstream watershed stations to the Buffalo River station at Ohio Street. Data collected at the upstream stations would reflect runoff from the rural portions of the watershed. The difference in the

TABLE 5.10
COMPARISON OF UPSTREAM WATERSHED AND BUFFALO RIVER
1987 DEC WATER QUALITY MONITORING DATA
(ug/l)

Parameter	Upstream Watershed Station Mean 1/	Buffalo River Station Mean 2/
copper	6	9
iron	658	1410
lead	1	7
manganese	43	86
zinc	11	16

1/ Flow weighted mean of three monitoring stations located on Cayuga Creek at Alden, Buffalo Creek at Blossom and East Branch Cazenovia Creek at East Aurora

2/ Ohio Street monitoring station

mean concentrations between the upstream stations and the Buffalo River station would reflect additions from the urban-suburban area of the watershed.

A National Urban Runoff Study issued by EPA in 1983 indicates the presence of metals and cyanides in urban runoff. Copper (1-100 ug/l), lead (6-460 ug/l), and zinc (10-2400 ug/l) were by far the most prevalent constituents found. All were found in at least 91 percent of the samples. Among the other inorganic parameters detected in the EPA urban runoff study were arsenic (1-50 ug/l) in 52% of the samples and cyanides (2-300 ug/l) in 23% of the samples. Barium, iron and manganese were not analyzed as they are not EPA priority pollutants.

Buffalo River sediments exceed open lake disposal criteria. Potential sources are inactive hazardous waste sites, combined sewer overflows, other point sources and nonpoint sources based on sample observations.

Low Dissolved Oxygen

Impairment Observations. Dissolved oxygen is not a contaminant but is required to sustain aerobic biological life in a water body. Oxygen is extracted from the water as a result of chemical reaction and biological respiration. High levels of dissolved oxygen are maintained in the Buffalo River except during summer low flow periods. Dissolved oxygen levels from mid-day collections at one meter below the surface at the Ohio Street Bridge during summer low flow periods from 1982 to 1986 have ranged from 3.2 to 6.8 mg/l (38 to 79 percent saturation).

Sources. The presence of oxygen demanding substances from domestic wastes has been substantially reduced by the attainment of secondary treatment or greater for all municipal wastewater treatment facilities in the Buffalo River basin. Chemical oxygen demanding substances are also limited for the small number of industrial discharges to the Buffalo River system through the State Pollutant Discharge Elimination System (SPDES) program. The lower Buffalo River, with its dredged depth of 22 feet below low lake level datum, is a deposition area where organic sediments associated with watershed runoff can settle out and generate a benthic oxygen demand on the overlying water. The extent of the dissolved oxygen demand throughout the waterway was assessed under spring and summer flow conditions in 1982. Minimum mean dissolved oxygen conditions mid-way along the Buffalo River (Mile Point 3.7) ranged from 3.2 mg/l in the summer (60 mgd stream flow) to 5.7 mg/l in the spring of 1982 (about 190 mgd stream flow).

Potential sources in addition to bottom sediments are; inactive hazardous waste sites, combined sewer overflows, other point sources and other nonpoint sources.

Physical Disturbances

Impairment Observations. Major modifications of the natural habitat of the Buffalo River have occurred as a result of bulkheading and dredging to facilitate commercial navigation. Fish habitat has been reduced resulting in spawning inhibition. Wetlands, which provide food and shelter for wildlife such as migratory waterfowl and animals, have been eliminated because of channelization.

Sources. The combination of bulkheading and dredging has eliminated many productive shallow waters in the Buffalo River. Suitable spawning substrate is lacking in areas of appropriate depth and velocity. Vegetated banks are lacking in many areas. Bank slopes are generally steep and have a high potential for erosion. The river also suffers from an absence of rooted aquatic vegetation. All of the above limit the development of a prosperous fish and wildlife population.

Summary of Impairments, Causes and Sources

A summary of impairments, causes, and sources is shown in Table 5.11. Contaminated bottom sediments are known sources of contaminants that in turn are known impairment causes. Other sources are possible but have not been quantified. Stream water quality monitoring correlated with flow is required to assess whether possible additional sources (eg. combined sewer overflows, inactive hazardous waste sites, other point and nonpoint sources as well as bottom sediments) in aggregrate produce contaminants that are likely impairment causes.

TABLE 5.11
SUMMARY OF IMPAIRMENTS
CAUSES AND SOURCES

No.	Impairments and Impairment Indicators	Impairment	Likely Causes	Known Sources	Potential Sources
1.	Restrictions on fish and wildlife consumption	Yes	Polychlorinated biphenyls	Bottom sediments	Inactive hazardous waste sites
			Chlordane		Bottom sediments
2.	Tainting of fish and wildlife flavor	Likely	Polynuclear aromatic hydrocarbons	Bottom sediments	Inactive hazardous waste sites Combined sewer overflows
3.	Degradation of fish and wildlife populations	Likely	Low dissolved oxygen 1/		Bottom sediments Inactive hazardous waste sites Combined sewer overflows Other point sources Other nonpoint sources
4.	Fish tumors and other deformities	Yes	Polynuclear aromatic hydrocarbons	Bottom sediments	Inactive hazardous waste sites Combined sewer overflows
5.	Bird or animal deformities or reproduction	Likely	Polychlorinated biphenyls	Bottom sediments	Inactive hazardous waste sites
			DDT and metabolites		Bottom sediments
6.	Degradation of benthos	Yes	None identified	Not applicable	Not applicable
7.	Restriction on dredging activities	Yes	Metals and cyanides	Bottom sediments	Inactive hazardous waste sites Combined sewer overflows Other point sources Other nonpoint sources

TABLE 5.11 (CONTINUED)
SUMMARY OF IMPAIRMENTS
CAUSES AND SOURCES

No.	Impairments and Impairment Indicators	Impairment	Likely Causes	Known Sources	Potential Sources
8.	Eutrophication or undesireable algae	No	Not applicable	Not applicable	Not applicable
9.	Restrictions on drinking water consumption or taste and odor problems	No	Not applicable	Not applicable	Not applicable
10.	Beach closings	No	Not applicable	Not applicable	Not applicable
11.	Degradation of aesthetics	No	Not applicable	Not applicable	Not applicable
12.	Added costs to agriculture or industry	No	Not applicable	Not applicable	Not applicable
13.	Degradation of phytoplankton and zooplankton population	No	Not applicable	Not applicable	Not applicable
14.	Loss of fish and wildlife habitat	Yes	Physical disturbance	Bulkheading Dredging Steep bank slopes	Lack of suitable substrate

1/ River channelization is also a potential factor

CHAPTER 6

REMEDIAL PROGRAMS AND OPTIONS

Introduction

A number of remedial programs are ongoing which have or are being implemented to address sources of contaminant entry into the Buffalo River. These programs are described in this Chapter to provide the reader with an overview of pollution control remedial programs in effect in New York State. Remedial options that could apply to known or potential causes of impairment in the Buffalo River are also discussed.

Remedial Programs

The major programs which affect contaminant entry into water bodies are those which address municipal and industrial discharges, combined sewer overflows, inactive hazardous waste sites and other nonpoint sources. Program development is required for contaminants in river bottom sediments.

Municipal and Industrial Discharges

New York State has chosen the "Substance Specific" approach as the primary method of water-quality-based toxic substance management and control for point sources. Water quality standards and guidance values have been adopted for over 200 toxic substances in both fresh and marine waters for the protection of human health and aquatic life. These are in addition to federally mandated technology-based treatment standards, and best professional judgment where such standards are lacking. As a secondary mechanism of toxics control, whole-effluent toxicity testing (exposure of the organisms Daphnia magna and Pimephales promelas) is being included in "third round" permits, particularly where water-quality-based controls may not assure conformance with water quality standards.

In New York State, the identification of waters needing water-quality-based controls began in the 1960's through the project/basin assessment process. This process focused on the control of conventional, non-toxic pollutants (biochemial oxygen demand, suspended solids, pH, etc.) from municipal and industrial discharges. In the late 1960's New York also began requiring technology limits based on the permit writer's "best professional judgment".

The Federal Water Pollution Control Act of 1972 officially required both treatment technology and water quality based effluent limitations. By this time, New York State already had half a decade of experience in writing permits that contained water quality limitations and was developing the experience to create other workable treatment technology limitations. Moving into the arena of uniform national wastewater-treatment-technology standards proved to be a very slow process, fraught with controversy and law suits.

Relative to the control of toxic discharges to New York State's waterways, the most important new feature of the 1972 Water Pollution Control Act was the legal requirement to establish national industrial wastewater treatment technology standards in the form of "Best Available Treatment Economically Achievable". For the various categories of industry, EPA was to promptly develop uniform national guidance documents containing treatment technology values for: Best Available Technology (BAT); New Source Performance Standards; and Industrial Pretreatment Requirements. The industrial discharges were expected to comply with these technology guidelines by 1983 for BAT and by 1984 for industrial pretreatment.

It was 1981 when the first set of EPA industrial technology guidance documents appeared for the electroplating category of industries. In the absence of these national industrial technology standards, the project review engineers in New York State assigned with the responsibility to approve wastewater treatment facilities for industries gradually developed a comprehensive body of guidance values based on their own "best professional judgment" of what BAT should be. In 1983 New York formalized these best professional judgment (BPJ) values in the form of written policy guidance for the issuance of wastewater permits. At the present time permit writers use federal BAT guidance where available and state BPJ guidance values for all other industrial categories. As of this time, EPA has promulgated its forty-fifth set of industrial wastewater-treatment guidance values.

As the number of substance-specific ambient water quality criteria increased, a formal tabulation was prepared in 1983. The procedure for the development of criteria was incorporated into regulation in 1985, as were many of the substance-specific numerical criteria. The criteria are called "standards" if in regulation and "guidance values" if not. Standards or guidance values currently exist for about 215 toxic substances for both fresh and marine waters.

Prior to the development of "third round" permits, a basin approach to toxic substances control was initiated (1981 to 1984). This was consistent with the total maximum daily load (TMDL) and wasteload allocation (WLA) concept contained in the EPA regulation "Water Quality Planning and Management", 40 CFR 130. To implement the basin approach, a toxic discharge inventory for each substance is developed.

This is compared to the maximum allowable load in the most critical downstream segment in each basin under critical low flow conditions. The assumption is made that all toxic substances are conservative. That is, a substance which enters the water column remains in downstream segments unaffected by biological, chemical, and physical processes.

DEC reviews the self-monitoring reports from dischargers, flagging any which exceed permit limits and using pre-determined criteria to assess significance (toxics are considered more significant than conventional pollutants, and large or frequent violations more significant than small or occasional exceedances).

In addition, DEC inspects facilities in operation and independently samples effluent to check the validity of self-monitoring data. Inspections often detect small operational problems before they grow into permit violations, and are focused on facilities with a history of problems and on dischargers to sensitive receiving waters.

Significant violations of permit conditions trigger compliance or enforcement measures. In extreme cases, DEC may impose summary abatement or closure to end an immediate or very serious health or environmental threat. The department can also pursue criminal or civil penalties for illegal discharge. The common initial approach, however, is establishment of an "integrated compliance strategy" to abate the discharge as quickly as possible. The violator is obligated to follow the compliance strategy, which may include construction, corrective maintenance or changes in operation. DEC surveillance of the discharger is increased until permit limits are achieved.

Today, New York State has in place and exercises the elements needed to control the discharge of toxics to surface water from point sources. These elements include:

- SPDES permit authority which has demonstrated successful control of toxics and conventional pollutants;

- Written procedures for setting effluent limits for toxics;

- Federally promulgated technology-based treatment standards and DEC's best professional judgment technology-based standards;

- Water-quality standards for 95 toxic substances;

- Criteria for more than 120 additional toxic substances (these criteria will become standards in the future, and are used in setting permit limits);

- A statewide basin-by-basin inventory of toxic substance discharges;

- A State laboratory certification program to ensure the reliability of effluent monitoring by dischargers;

- Stringent civil and criminal penalties for illegal discharge;

- A program to monitor dischargers and to achieve compliance;

- Citizens and public officials who are determined to keep surface waters free of toxic contamination.

Industrial Pretreatment Program. The Buffalo Sewer Authority (BSA) Industrial Pretreatment Program has regulatory authority over 174 Significant Industrial Users (SIUs) within the City of Buffalo, the Villages of Sloan, Depew, Lancaster, and the Towns of Cheektowaga, Lancaster and West Seneca. Thirty-seven SIUs are subject to Federal Categorical Pretreatment Standards. All SIUs are subject to the Federal General Pretreatment Regulations and BSA Sewer Use Regulations.

All SIU's within the BSA service area have been issued Buffalo Pollutant Discharge Elimination System (BPDES) permits. BPDES permits, analogous to State issued SPDES permits for surface or ground water discharges are pollutant specific and limit the volume, mass and concentration of allowable pollutant discharges into the BSA sewer system. BPDES permits, issued for a three year duration, also specify SIU self monitoring, reporting and recordkeeping requirements.

The BSA inspects SIUs on an annual basis and samples SIU discharges for permit compliance on a semi-annual basis. SIUs are, at a minimum, required to sample their effluents and report sample results to the BSA on a semi-annual basis. BSA enforcement action in response to SIU non-compliance may include civil or criminal penalties and termination of service.

The program was approved by the EPA in 1984 and fully implemented, with DEC overview, in 1985. The program encompasses the entire BSA service area.

Inactive Hazardous Waste Sites

The New York State Abandoned Sites Act of 1979 (Chapter 282) marks the formal beginning of New York State's Inactive Hazardous Waste Site Remedial Program. The Abandoned Site Act mandated a statewide inventory of inactive hazardous waste sites, established the New York Registry of Inactive Hazardous Waste Sites, and provided DEC and the Department of Health the authority to order responsible parties to clean up their waste sites, or to initiate cleanup activities in the event that no responsible party could be identified.

The abandoned Sites Act spotlighted New York State as a leader in the hazardous waste remedial cleanup arena. Federal regulation came about somewhat later with the passage of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA or Public Law 96-510).

As more sites were discovered and the need for additional funding became evident, New York enacted the State Superfund Law of 1982 (Chapter 857). This law established the Hazardous Waste Remedial Fund (State Superfund) from fees assessed against wastes generated in or transported into New York State. These monies were dedicated to pay for site investigation, remedial programs at sites where there was no responsible party, financing the non-federal share of remediation activities carried out under federal Superfund, and emergency response actions for spills involving hazardous waste.

Five classifications for hazardous waste sites are specified in the Environmental Conservation Law (ECL) to be used by DEC in preparing the registry of inactive hazardous waste disposal sites. The classifications are:

<u>Classification 1</u> - causing or presenting an imminent danger of causing irreversible or irreparable damage to the public health or environment -- immediate action required;

<u>Classification 2</u> - significant threat to the public health or environment -- action required;

<u>Classification 3</u> - does not present a significant threat to the public health or environment -- action may be deferred;

<u>Classification 4</u> - site properly closed -- requires continued management;

<u>Classification 5</u> - site properly closed, no evidence of present or potential adverse impact -- no further action required.

<u>Classification 2a</u> has been added by DEC. This temporary classification has been assigned to sites for which there is inadequate data to assign them to the five classifications specified by the law.

The Superfund Law required DEC to prepare the Inactive Hazardous Waste Remedial Plan. The plan was to identify both methods and schedules for completing the hazardous waste remedial program in New York State. It also authorized the creation of the first State Superfund Management Board whose function was oversee the remedial program as outlined in the Remedial Plan. Upon completion of its legal mandate in June 1984, the original Board ceased to exist.

Governor Cuomo issued Executive Order #33 on

December 29, 1983 mandating DEC to survey industry's past hazardous waste disposal practices. Questionnaires were distributed to nearly 15,000 industries suspected of generating or transporting hazardous wastes during the thirty-year period from 1952 to 1981. Approximately 60% of the questionnaires sent out were returned; 449 potential new disposal sites were identified. These sites required further investigation in order to decide which sites should be added to the Registry of Inactive Hazardous Waste Sites. The report of suspected waste sites was released April 1, 1985.

The State anticipated $10 million per year in receipts from the waste-end assessments on industries that generate or transport hazardous wastes in New York State. In actuality these assessments yielded only $3.5 million per year. To remedy this shortfall, the State passed the 1985 Amendments to the State Superfund Law (Chapter 38). The 1985 Amendments authorized a significant increase in revenue totaling $22 million per year through industry-based fees. In addition, $8 million was appropriated out of the State's General Fund, thereby making available a total of $30 million to fund New York's remedial program.

The 1985 Amendments require DEC to publish Quarterly Reports indicating progress made in enforcement, site investigation and/or remedial activities at each site listed in the Registry. The Department was also required to prepare a status report and annual update of the Remedial Plan by July 1, 1986, and in each successive year. This law constituted the second State Superfund Management Board, directing it to evaluate the State's implementation of the New York State Hazardous Waste Site Remedial Program.

With Superfund revenues of $22 million per year (plus $8 million from the State's General Fund), it was estimated that it would take at least 40 years to fund the State's share of remediating an estimated 500 hazardous waste sites. In order to complete cleanup within the State Superfund Management Board's accelerated 13-year schedule, an additional funding commitment was needed from both industry and government. Governor Cuomo therefore proposed issuance of the Environmental Quality Bond Act of 1986 to raise $1.45 billion. Of this amount, $1.2 billion is earmarked for remedial action at hazardous waste sites when other sources of funding are not available. Debt service incurred on the bonds issued to clean up hazardous waste sites will be shared equally by New York State and industries that produce or process hazardous waste. In 1986, the Legislature approved and Governor Cuomo signed the Bond Act authorizing a referendum for voter approval. On November 4, 1986, the Bond Act was approved overwhelmingly by voters of New York State.

Once a hazardous waste site is listed in the Registry, the State must (1) determine whether hazardous waste at the site constitutes an imminent or significant threat to the environment or public health, and (2) identify potentially responsible parties. Priority for action is dependent upon the type of waste deposited at the site, the potential for contaminant migration and the presence of groundwater or surface water contamination from the site.

DEC conducts two levels of preliminary investigations (Phase I and Phase II) at suspected inactive hazardous waste sites. For Phase I studies, DEC hires engineering consultants to search records of federal, state, and local agencies known to be involved with the site, and to interview site owners (if known) and local residents to gather pertinent information on the site. Phase I site investigations provide preliminary characterizations of hazardous substances present at each site; estimate pathways by which pollutants might be migrating from the original site of disposal; identify population or resources which might be affected by pollutants from the site; observe how the disposal area was used or operated; and gather information regarding who might be responsible for wastes at the site. They also identify data gaps necessary for proper assessment of the site's characteristics. Phase I studies typically require eight to twelve months to complete.

If additional information is needed to classify and rank a site, DEC will conduct a Phase II investigation to determine whether or not the site poses a significant threat to public health and the environment. Data gathered in the Phase II study are used to classify the site, to apply these data to the EPA Hazard Ranking System Model to determine whether the site should become part of the National Priorities List (Federal Superfund site list) and to identify the needs (if required) of a Remedial Investigation/Feasiblity study. Phase II studies typically require more than one year to complete.

A Remedial Investigation (RI)/Feasibility Study (FS) is undertaken when a site is determined to pose a significant threat to public health or the environment, i.e. a class 2 site in New York State's priority system. The Remedial Investigation is designed to determine the areal and vertical extent of contamination whereas the Feasibility Study provides the analysis and recommended solution to the particular site problem. An RI/FS normally requires about two years to complete.

Once a remedy is selected, a remedial design is prepared and the remedial construction is carried out. Remedial designs typically require one year while remedial construction may take several years to complete depending on the complexity of the site.

Bottom Sediments

No formal programs to address contaminated bottom sediment currently exist at the federal or state level.

In the Great Lakes Amendment to the U.S. Clean Water Act, the EPA Great Lakes National Program Office is authorized to "carry out a five year study and demonstration projects relating to the control and removal of toxic pollutants in the Great Lakes, with emphasis on the removal of toxic pollutants from bottom sediments." Five areas were suggested as ones that should receive priority consideration as sites for the demonstration projects. All five are Areas of Concern as identified by IJC for RAP development. The Buffalo River is in this group. The Amendment authorizes the expenditure of $4.4 million per year for Federal Fiscal Years 1987-1991 for the demonstration projects. For the period October 1987 through September 1988 Congress appropriated $1.8 million for the initiation of this program by the EPA Great Lakes National Program Office.

Combined Sewer Overflows

Combined sewer overflows are included in municipal State Pollutant Discharge Elimination System permits as separate discharge points. No dry-weather overflows are allowed from a combined sewer system. DEC has provided guidance through the Technical and Operation Guidance Series (TOGS) for decisions in the evaluation of CSOs to ensure that water quality objectives are met, and to protect the best usage of the State's water resources from significant impairment by the direct and residual degrading effects of CSOs through the elimination or reduction of CSO discharges.

EPA and DEC, through the Construction Grants Program, have awarded grants to CSO abatement projects designed to restore uses of the receiving waters in priority water quality areas which have been impaired by the impact of CSOs. A revolving loan program is proposed as a source of continuing financial support for remedial activity with the phase out of the current construction grant program for wastewater facilities.

Other Nonpoint Sources

A nonpoint source (NPS) of pollution is usually considered an areawide source or many small sources of pollution distributed diffusely over an area, which cumulatively make a significant contribution to water quality degradation. Toxics may enter surface waters either dissolved in runoff or attached to sediment or other organic materials and may enter groundwater through soil infiltration. Contaminants transported from the land by runoff following a storm event are usually characterized as nonpoint if they enter the waterbody diffusely rather than at a discrete stormwater discharge point.

NPS impacts are associated with both long-term, fixed land uses (e.g., agriculture, urban development) and more sporadic and transitory activities (e.g., construction sites, timber harvesting). Programs to address activities such as forestry and construction must be preventive in nature; i.e., they must promote awareness and understanding of proper site management before a project is undertaken so that site-specific impacts can be prevented. On the other hand, the impacts of agricultural or urban land uses typically manifest themselves as identifiable longer-term problems in a waterbody (e.g., eutrophication of a lake or reservoir) which must be prevented or corrected by efforts to promote proper long-term management practices on the landscape.

Addressing nonpoint source pollution involves a broad array of program activities on the part of several federal, state and local agencies. In New York State, the DEC has lead responsibility, by virtue of its statutory authority, for the management of water resources and control of water pollution.

"Best Management Practices" (BMPs) are essential tools to better link water quality with the land management activities of pertinent resource management agencies and with the activities of local government. Since most of the institutional capability for implementing management practices to control NPS exists at the local level, cooperation and coordination among agencies is an essential part of "outreach" to develop awareness and enthusiasm for BMPs on the part of local government and the public.

Nonpoint sources of water pollution within the scope of the State's management strategy which may include substances of a toxic nature are: diffuse urban runoff; household on-lot wastewater disposal; chemical and petroleum bulk storage; pesticide and fertilizer use in agricultural and silvicultural operations by commercial turf grass, yard care, and vegetation control operations, and by homeowners; small spills, accidents and leaks of hazardous substances associated with poor housekeeping at industrial and commercial facilities; and storage and use of road salt and other deicing chemicals and abrasives.

Some examples of NPS control related activities/ programs are:

- Septic tank control programs under the New York

State Department of Health and county health departments which enforce standards for on-lot wastewater disposal systems.

- Chemical and petroleum bulk storage programs administered by DEC which require owners to register, periodically test and inspect storage systems and report results to the department. These programs require that the repair or replacement of leaking facilities must be in accordance with standards for new installations.

- Training and certification of commercial and private (farmer) pesticide applicators by DEC. DEC also registers and classifies products for use in New York State with authority to cancel these registrations if necessary. DEC is also responsible for the pesticide enforcement program to deter misuse of pesticides.

- The Agricultural Conservation Program of the U.S. Department of Agriculture which is used to partially fund soil and water conservation BMPs on private land.

While the total amount of activity that may be considered NPS control related during the past few years has been substantial, collectively the activities have not constituted a defined program. There has been no articulated framework or strategy to provide the various individual efforts with a common management direction.

As the major point sources of water pollution are brought under control in New York, as well as nationwide, the water quality impacts of NPS become relatively more apparent. In recognition of these impacts, the Water

Quality Act of 1987 provides new direction and authorizes Federal assistance for the preparation and implementation of state NPS programs.

Under the Water Quality Act, the State is required to submit, for EPA approval, an assessment report identifying those waters that cannot reasonably be expected to attain or maintain applicable water quality standards or the goals and requirements of the Clean Water Act due to NPS pollution. This report will also describe the specific NPS categories affecting these waters and general programs and methods used for controlling this pollution.

The State is also required to submit, for EPA approval, a NPS management program providing an overview of the State's NPS program, as well as what the State intends to accomplish over the next four years. While the assessment report will identify the overall dimensions of the NPS problem, the management plan will target a subset of these waters on a watershed-by-watershed basis. Statewide approaches to problems such as urban stormwater runoff from developing areas may also be developed.

Remedial Options

Remedial options for inactive hazardous waste sites, bottom sediments, combined sewer systems and fish and wildlife habitat are discussed as follows. These options represent the alternatives from which remedial actions most likely will be selected.

Inactive Hazardous Waste Sites

A summary of remedial action techniques for inactive hazardous waste sites is presented in Table 6.1.

TABLE 6.1

SUMMARY OF AVAILABLE REMEDIAL ACTION TECHNIQUES FOR HAZARDOUS WASTES

Technique	Functions	Applications/Restrictions	Estimated Cost
Land disposal	Disposes of waste materials in landfills.	Most widely used method for waste disposal; improper disposal can result in air pollution, ground-water and surface water contamination; RCRA requirements will markedly increase the cost but will provide for more sound disposal methods	$90 - 200 per ton
Incineration	Thermally oxidizes waste material in controlled environment.	Most effective for all organic wastes, especially those with low flash points and containing relatively low ash contents. Applicable to wastes that are oxidizable at temperatures below 2500 $^{\circ}F$	$400-500 per ton

TABLE 6.1 (Continued)

Technique	Functions	Applications/Restrictions	Estimated Cost
Solidification	Incorporates waste material into immobile matrix such as cement or resin	Most economical for small quantities of waste. Waste material must be compatible with solidification agent. Not well demonstrated for nonradioactive wastes; may leach from some matrices over time	$50-150 per ton
Encapsulation	Surrounds waste material with impermeable coating	Most applicable to containerized waste materials or dewatered sludges; not fully demonstrated; costly	$100-140 per ton
In-situ solidification	Injects waste solidification agents directly into waste site, or immobilizes waste by vitrification	Applicable to liquid wastes from surface impoundments and well defined landfill sections. Not applicable to containerized wastes	$100-150 per ton
In-situ neutralization/ detoxification	Neutralizes or immobilizes wastes by application of a neutralization	Most applicable to surface impoundments and disposal sites with permeable surfaces for metal-bearing wastes. Degree of effectiveness may	$25-150 per ton

TABLE 6.1 (Continued)

Technique	Functions	Applications/restrictions	Estimated Costs
	agent such as lime to the waste material, or deto-xifies waste by chemical reaction	be difficult to determine	
Microbial seeding	Biodegrades organic wastes	Most effective for landforms and surface impoundments; can degrade a wide range of organics when accli-mated; degradation process is slow and requires adequate aeration	$15,000 per acre

References for Cost Estimates - Table 6.1

- "Remedial Action Technology for Waste Disposal Sites"
  P. Rogoshewski, H. Bryson, K. Wagner, 1983

- "Wide Beach Superfund Site Pilot Testing of Chemical Treatment"
  Glason Research Corporation, March 1988

- "RI/FS for the 93rd Street School Site"
  Loureiro Engineering Associates, March 1988

- "Remedial Action at Waste Disposal Sites"
  USEPA, October 1985

Bottom Sediments

Remedial options for the Buffalo River include excavation (spot or entire) or retention-in-place through natural or man-made armoring and discontinuation or modification of dredging for navigational purposes.

To assess excavation feasibility and costs, bottom sediment criteria would have to be established, investigations would have to be conducted of the horizontal and vertical distribution of contaminant levels, volume estimates would have to be prepared, disposal site capacity would have to be established and dredging mechanisms would have to be evaluated to determine the least disruptive method of bottom sediment removal.

The remedial alternative of excavation for contaminated bottom sediments would require a detailed survey, analysis and mapping of the river bottom to depict the horizontal and vertical extent of contamination. Analytical chemical, physical and biological data would be compared with sediment quality criteria to determine the degree to which excavation would be required to effectively remove the contaminants.

A pilot project was undertaken over approximately an 0.3 mile segment of the Buffalo River, to assess the procedures, extent of sediment contamination and contaminant level correlations among sediment data. Concurrent toxicity testing was conducted to assess the impacts of contaminants in the bottom sediments. Bioassay studies were performed by DEC and are described in Chapter 4.

Sampling and chemical analyses were performed by Erie County under contract with DEC. Cores were collected on transects established at 100 foot intervals on the Buffalo

River by the U.S. Army Corps of Engineers from Station 735 to 751. Cores were attempted at five locations across each transect; at the 10 foot and 18 foot water depth on the stream banks and at the channel center. An attempt was made at each location to obtain a sediment core using a 48 inch vibracore tube. In some cases, a sediment core could not be obtained due to the presence of rock or high soil density and a surficial grab sample was attempted. Grab samples were also obtained at an upstream control area.

Sediment cores (from 8 to 48 inches in length) were sectioned into three portions, where possible, for analysis. The sediments were analyzed for heavy metals, pesticides, PCBs, PAHs and volatile solids. Elutriates were analyzed for heavy metals as an indication of the potential of the contaminants to leave the sediment and enter the dissolved phase during agitation. The major conclusions of this pilot project were:

- That analytical quality control showed inconsistent recovery and reproducibility. Inferences from such data are uncertain.

- That if removal of sediment were predicated on metals, most other contaminants would also be largely removed.

- That there is no correlation between elutriate metal and bulk metal concentrations, confirming the fact that bulk metal concentrations are not a good predictor for contaminant release.

- That the samples taken close to each other are no more likely to be similar than those taken far apart, that samples collected at 100 feet intervals are not excessive and that the variability of analytical results confirmed the heterogeneous nature of bottom sediment contamination.

- That substances examined show lower contaminant concentrations at the surface because of either a greater dilution from cleaner sediments or a lower contaminant loading rate.

- That sediment cores longer than 48" may be required to measure the full depth of contamination.

A comparison of data collected along the stream banks with stream centerline bottom sediment contaminant levels indicates a need for further evaluation of potential contaminated sediment addition to the Buffalo River from lower river stream bank erosion.

The potential exists for the retention-in-place of contaminated bottom sediments through natural or man-made armoring and the discontinuance or modification of current dredging practice. Sediment erosion varies along the length of the river and occurs as the consequence of variations in stream flow from the watershed. Generally, sediments erode during high flows and are deposited during low flows. The Buffalo River is an aggrading stream, in that it tends to accumulate sediment over time, exporting less sediment past its mouth than is added from its tributaries.

Another process that occurs as a result of erosion and scour of the sediments is a natural sorting of material by particle size. The subsequent covering and compaction of sediment layers result in a phenomenon known as armoring. The resultant armored layers are more resistant to erosive forces. Study of the sediment dynamics of the Buffalo River along with examination of sediment cores indicates that armoring occurs. Several armoring layers would be expected to be produced over a period of years because of the aggrading nature of the river.

Dredging tends to destroy the armoring layers as the process entails cutting through and removing the uppermost sediment layers. A remedial option of retention-in-place of bottom sediments would likely require a modification or discontinuance of existing dredging practice. Further field investigation would be required to more fully understand the sediment bed characteristics and location of existing armoring layers. Computer simulation modeling of the dynamics of bottom sediment movement and the effects of alternative dredging practices would be required to assess the remedial potential of this option.

To develop an understanding of sediment movement in the Buffalo River, two investigations have been performed involving computer modeling of the dynamics of sediment transport in the river system. Both studies were accomplished under contract with DEC.

The objectives of the first investigation performed by Rumer and Meredith in 1987 were to:

- Analyze the historical runoff record for the three upstream tributaries,

- Calculate sediment yields from the tributary drainage basins, and

- Perform an initial assessment of sediment deposition and scour in the Buffalo River.

The first two objectives were accomplished through the evaluation of streamflow records of the U.S. Geological Survey and sediment yield studies of the Agricultural

Research Service of the U.S. Department of Agriculture conducted in the 1950's and early 1960's. From these evaluations, sediment loadings varying with streamflow were determined. These loadings served as input for the initial analyses of sediment transport, deposition and scour.

Sediment transport was evaluated through the use of the computer simulation model HEC-6 developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers. The model was calibrated through the use of extensive river bottom profiles developed by the U.S. Army Corps of Engineers - Buffalo District as part of their dredging program. The model was used to assess scour and deposition under varying flow conditions in the river. The ability of the river to "trap" incoming sediment loads was estimated . A limitation of the HEC-6 model was its inability to predict the dynamics of scour for the finer (clay and silt) sediment particles.

A second investigation performed by Raggio, Jirka and Pacenka in 1988 expanded upon the previous work. The objectives of this investigation were to:

- Modify the HEC-6 model to evaluate scour and deposition of fine sediment particles, and

- Perform time-series simulations to evaluate the long-term effects of sediment movement in the river.

The model was modified to incorporate the theoretical relationships associated with scour and deposition of fine sediment particles in the Buffalo River. Field testing and laboratory soil testing were used to determine shear stress coefficients for inclusion in the model. The model was used to perform long term (25 year) time-series simulations.

It was concluded that through the resuspension of fine sediment particles, armoring layers consisting of heavier soil particles develop in the river bed. The long-term simulations identified the areas where armoring layers as well as scour would be likely to occur. It was shown that the model, as modified, has the potential for being a useful tool in the evaluation of remedial alternatives. Scour, deposition and the development of armoring layers can be evaluated in future work based on alternative modifications of current dredging practice.

Prior to undertaking any remedial actions relative to the bottom sediments in the Buffalo River it will be necessary to demonstrate that there are no continuing sources of unacceptable levels of sediment contaminating constituents in the Buffalo River system.

Contaminant levels in the water column need to be assessed with lower detection limits to provide assurance that contaminants at levels that would be detrimental to successful remediation are not present.

Combined Sewer Systems

Remedial options for combined sewer systems include enhanced conveyance capability (removal of any system restrictions), increased treatment capability, development of in-system storage through operational modification and use of off-system storage for post storm conveyance and treatment. The potential of the above options and their associated costs is currently being investigated by the Buffalo Sewer Authority (BSA). A report on the assessment of these options is scheduled to be completed by the BSA in 1989.

Fish & Wildlife Habitat

In addition to toxic substances several habitat conditions have been identified as having potential to limit or adversely affect aquatic resources in the area of concern. The conditions identified are: dissolved oxygen, turbidity, siltation and other physical habitat alterations. Understanding these habitat conditions, as they currently exist, is important to understanding potential impacts and limitations on the aquatic community.

Characterization of dissolved oxygen and turbidity conditions in the area of concern are a component of water quality monitoring programs. Dissolved oxygen and temperature profiles, particularly during the spring, summer and fall periods are necesary to assess the quality of fish habitat. Characterization of turbidity conditions during this time frame is also desirable.

The following are short and long term strategies for investigating and correcting aquatic habitat conditions.

Short-term Strategies

A. Create a more naturalized and aesthetic Buffalo River corridor by encouraging creation of a greenbelt along the river corridor.

B. Enhance shoreline habitat conditions:

    1. allow at least 25% of the river's bank and adjacent areas to remain in a vegetated condition.

    2. encourage the replacement of abandoned, deteriorated bulkheads with rip rap or gabion shoreline protection.

3. remove construction/demolition debris from the river's shoreline and nearshore shallow water areas.

4. regrade and revegetate unstable river banks which have high potential for erosion.

C. Develop and execute a plan for studying sources, types and rates of siltation/sedimentation in the area of concern as well as the reduction of watershed erosion through implementation of best management practices (BMPs). The primary emphasis of the plan would be to determine how fish populations (and other biota), particularly early life cycle stages, may be affected by this process. Potential for correcting any adverse impacts should also be investigated.

D. Develop angler access to the Buffalo River.

Long-term Strategies

When water quality and siltation conditions have been more completely evaluated, it will be necessary to more fully assess the physical habitat conditions present in the area of concern. This would be done in relation to the habitat requirements of specific fish species. If specific habitat requirements are not present, then recommendations to remediate these conditions may be made. For example, to enhance spawning and nursery habitat for northern pike, an area of emergent marsh habitat may be suggested for construction. Another example might be to enhance spawning habitat for walleye by suggesting that suitable substrate material be placed in areas of appropriate depth and velocity.

Recommendations for physical habitat improvement would be made in consideration of navigational and dredging requirements.

CHAPTER 7

RECOMMENDED REMEDIAL STRATEGY

Introduction

The recommended remedial strategy for the Buffalo River is described in this Chapter along with Buffalo River Citizen Committee (BRCC) implementation, legislative and budgetary recommendations.

A schematic illustrating the recommended remedial strategy is presented in Figure 7.1. The strategy provides a systematic, focused approach to address use impairments in the river. It is designed to assure maximum effectiveness in progressing through the remedial process. The schematic includes the identification of sources or physical habitat, remedial actions, decision points and the interrelationship of all of the above.

Remedial actions are aligned horizontally in the schematic by contaminant sources or physical disturbances. This alignment identifies each major remedial action and the sequence of each action. The first actions to be undertaken in each alignment are noted in the text as initial remedial actions. These actions are the activities which require initial funding commitments to initiate the remedial process. The remedial actions have in many instances been described in earlier chapters as program elements or activities required to implement a remedial option. The schematic identifies the actions required for decision making in the remedial process. The interdependence of the various remedial actions is illustrated and linked vertically in the schematic. The schematic illustrates how the contaminants and their levels which cause impairment will be identified, how contaminant sources will be isolated, how corrective action will be achieved and how the completed remedial actions will be monitored to assure goal attainment.

The strategy described in this chapter includes Buffalo River Citizen Committee (BRCC) recommendations associated with each remedial action. These BRCC recommendations are noted in brackets. The BRCC recommendations will be incorporated in the planning for specific remedial actions.

Legislative and budgetary recommendations prepared by the BRCC follow the remedial strategy description.

Remedial Actions

Stream Water Quality Monitoring

Stream water quality monitoring is required to assess attainment of water quality standards and the potential for continuing bottom sediment criteria exceedance. A determination that the potential for continuing bottom sediment criteria exceedance would not be a concern would allow the implementation of bottom sediment remedial measures. A finding that continuing criteria exceedance does occur would require the address of specific contaminant entry sources prior to the commencement of bottom sediment remediation. Similarily, the exceedance of water quality standards would require the address of specific contaminant entry sources.

The DEC is currently attempting to establish a flow activated monitoring station on the Buffalo River that would allow sampling to be correlated with river flow. The intrusion of Lake Erie water into the Buffalo River is an effect that will have to be recognized to obtain reliable values. If such a station can be established and proven to work, in subsequent years upstream and downstream flow correlated monitoring will allow estimations to be made of loadings from the upper basin and from within the area of concern itself. These loadings, along with appropriate physical chemical properties of the pollutants, will allow recontamination potential to be modeled and the need for further loading reductions to be determined. The establishment of a flow activated monitoring station on the Buffalo River will be undertaken as an <u>initial remedial action</u>.

Indications from limited DEC monitoring suggest that dissolved oxygen levels during low flow periods are at levels in some portions of the river that would not support fish life. More extensive measurements must be carried out to determine dissolved oxygen levels in the river at various depths and under a range of flow and temperature conditions. If, as suspected, low dissolved oxygen levels are occurring, the role of organic matter in the sediments as well as other causes of oxygen depletion must be determined. The data obtained from these measurements will also be used to assess the benefits of supplemental water input to the Buffalo River from the Buffalo Harbor through the Buffalo River Improvement Corporation pumping and transmission system. This system has been in existence since 1967 to provide cooling water to the industries along the river. While it has a capacity of 120 mgd, current usage is less than 18 mgd. The assessment of dissolved oxygen levels in the Buffalo River will be undertaken as an <u>initial remedial action</u>.

[The BRCC recommends that a survey of the diversity of benthic organisms in sediments be conducted along with composite sampling of benthic organisms for body burden of toxic chemicals. This sampling is an element of the current Department monitoring. The BRCC also recommends that non-traditional, innovative funding sources, including grants, university based programs and cooperation arrangements with other agencies and private organizations be investigated to augment the Department's resources for the conduct of monitoring programs.]

Bottom Sediments

Bottom sediments in the Buffalo River are known to be contributing causes to three impairments and are potentially contributing causes to two others (Table 5.11). There are two types of options to address contaminated bottom sediments. One involves dredging, treatment/disposal and the other containment in-place through the use of man-made armoring or natural armoring. Natural armoring results from the accumulation and consolidation of overlying deposited sediments from the watershed. To assess the viability of bottom sediment armoring, it is necessary to understand the dynamics of sediment movement and bioturbation in the Buffalo River. Experience and knowledge have been obtained in modeling sediment transport in the Buffalo River using the recently modified quasi steady state one-dimensional sediment transport model HEC-6. To complete this evaluation additional model development is required including refinement of erodability equations for fine sediment along with further model calibration and characterization of sediment erosive properties. Model development will be undertaken as an initial remedial action.

Sediment criteria are required to determine the extent, both horizontally and vertically, of bottom sediment remediation necessary. The USEPA has been working to develop criteria over the past few years. The completion of this work and the application of these criteria to the Buffalo River are essential for the accomplishment of bottom sediment remediation. This development of bottom sediment criteria will be undertaken as an initial remedial action.

Upon completion of model development to assess the dynamics of Buffalo River bottom sediment movement and the development of sediment criteria, follow-up bottom sediment remedial actions would include:

- Modeling and evaluation of Buffalo River bottom sediment armoring alternatives based on natural and man-made armoring associated with potential modification of current river dredging practices.

- Buffalo River bottom sediment testing to assess current contaminant levels for comparison with bottom sediment criteria (developed as an initial action).

[The BRCC recommends that sediment sampling protocols be developed for sediment sampling in the Buffalo River giving priority to analysis for PAHs, PCBs and metals. The following specific protocols are recommended:

- establish initial sediment sampling station density based on previous contaminant and sediment accumulation data.

- review the stations annually and adjust the station density.

- utilize Corps of Engineers established baseline and establish similar reference lines for other sections of the river.

- specify procedures for equipment selection (e.g. gravity vs. vibracore or ponar dredge), preparation for sample collection, orientation of core samples, refrigeration during transit and procedures for securing sample aliquots from the cores.

- specify standard record keeping procedures including designating depth of sample below great lakes mean low water datum and depth of sample below river bottom.

- specify standard procedure to identify location of sampling points by USGS or other coordinates.

- identify indicator chemicals or tests to be used for monitoring (e.g. PCBs, PAHs, metals).

- specify acceptable sample preparation procedures (e.g. homogenization, extraction, etc.), analytical methods and quality assurance/quality control limits for sediment analysis.

The BRCC also recommends that chemical and biological contamination of the Buffalo River sediments be characterized following IJC guidelines and that a high resolution seismic survey be undertaken to measure sediment thickness. Sediment cores should be obtained and stratigraphic analysis should be done for lead 210 to indicate sediment accumulation rates. The rate of sedimentation, concentration and composition of water column particulates should be determined through the use of sediment traps.]

Continued action relative to Buffalo River bottom sediments would be dependent upon current contamination levels exceeding bottom sediment criteria.

The modeling and evaluation of natural and man-made armoring alternatives along with the initial estimates for sediment removal and treatment/disposal would permit the preliminary evaluation of alternatives to address contaminated bottom sediments.

Based on the preliminary evaluation and resulting preliminary alternative selection, data acquisition leading to specific alternative design would proceed. For sediment removal and treatment/disposal a detailed determination of sediment volume, based on criteria levels, would be required. Based on the treatment/disposal method selected, a treatment/disposal site would be identified, evaluated and acquired. With site acquisition, sediment removal design plus treatment/disposal facility design would proceed. As with the armoring alternative, Buffalo River monitoring data would be required to demonstrate that potential continuing sediment criteria exceedance would not be a concern. This would be required prior to armoring implementation or treatment/ disposal facility construction and implementation of sediment removal and treatment/disposal.

[The BRCC recommends that the sediment demonstration project for the Buffalo River authorized and currently funded through the Great Lakes Amendment to the Clean Water Act begin immediately. The contaminated sediment demonstration program directs the Great Lakes National Program Office of the Environmental Protection Agency to conduct innovative pilot treatment projects in targeted Great Lakes Areas of Concern. With the Buffalo River selected as a project location, it is recommended that the Environmental Protection Agency select representative samples of contaminated sediments in the river, test innovative removal/destruction technologies and report on the effectiveness and feasibility of these techniques. This pilot program is critical to the remedial action plan process in determining the appropriateness of any long-term clean-up effort for contaminated sediments.]

Inactive Hazardous Waste Sites

An on-going program for remediation of inactive hazardous waste sites is being implemented by DEC. [The BRCC recommends that remedial action at inactive sites focus on permanent solutions, eg. excavation and destruction, not containment. This can be accepted as ideal, however, cost will be a factor. The BRCC also opposes storage and destruction in the Area of Concern of contaminated materials that originate outside of the area of concern. The BRCC recommends that pilot innovative technology demonstration projects be undertaken on the Buffalo River watershed. In addition the BRCC endorses coordinated study and remediation of sites which affect one another. This is consistent with Department policy. The BRCC also urges that the remedial actions include targets for reducing toxic loadings at all sites in the watershed, timetables and implementation strategies. Site specific remedial plans will identify these. The BRCC urges that short term goals and long term goals be addressed along with plans for activities on high priority and low priority sites in relation to land use objectives. Additional site specific information will be required for ranking and priority setting.]

The initial steps in the program consist of Phase I investigations (existing data accumulation and assessment) and Phase II investigations (preliminary studies to fill data gaps necessary for initial site assessment). Based on the data obtained by these investigations, sites are ranked and determinations are made relative to the need to proceed with Remedial Investigation/Feasibility Studies.

Remedial Investigation/Feasibility Studies (define contaminant pathways and assess alternative remedial measures) are undertaken by the parties responsible for disposal of the waste at the site under Consent Order issued by DEC or by DEC in the absence of known responsible parties.

Phase I investigations of inactive hazardous waste sites have been completed or are underway for all of the sites in the Buffalo River Basin. Those underway will be completed by March 1989.

Phase II investigations have been completed at 4 sites (Madison Wire, Houghton Park, Mobil Oil and Tifft Farm and are underway at 2 additional sites (Allied Chemical and MacNaughton-Brooks). These sites along with seven more sites (Lancaster Reclamation, Town of Marilla, Land Reclamation, Old Land Reclamation, HiView Terrace, Donner-Hanna Coke and Lehigh Valley Railroad) are currently scheduled and are targeted for completion by March 1990.

Remedial Investigation/Feasibility Studies (RI/FS) are underway at 2 sites (Madison Wire and Buffalo Color) and will be completed by March 1990. One additional site (Union Road) is scheduled to have an RI/FS start during this period. Additional Remedial Investigation/Feasibility Studies will be initiated in the basin as warranted based on the results of the Phase II studies.

[The BRCC recommends that Phase II investigations and RI/FS studies be integrated with river monitoring to assure that upstream and downstream monitoring is conducted around points where leachate or sediment from inactive sites may be entering the river. This is usually done during the conduct of RI/FS studies.]

As with the combined sewer modeling studies, the inactive hazardous waste site Phase I, Phase II and Remedial Investigation/Feasibility Studies will provide data for the assessment of specific contaminant entry points related to the potential for continuing exceedance of bottom sediment criteria or water quality standards. Remedial design, implementation and monitoring of inactive hazardous waste sites will be undertaken based on the completed Remedial Investigation/Feasibility Studies.

Other Nonpoint Sources

While programs to address other nonpoint sources of pollution are ongoing, if specific entry points do not account for potential continuing exceedance of bottom sediment criteria or water quality standards, a focused nonpoint source assessment would be undertaken. Should the assessment indicate the potential of atmospheric transport as a controlable source of specific contaminants, atmospheric deposition modeling would be undertaken. Upon completion of the assessment and modeling, control method(s) (best management practices) would be selected, designed, implemented and monitored to demonstrate effectiveness.

[The BRCC recommends that priority be given to best management practices to control nonpoint sources. The BRCC urges the use of federal/state funds to promote and, if necessary, mandate best management practices by local government and private interests. Best management practices should focus on the flood plains of the Buffalo River watershed according to the BRCC. The BRCC also recommends that new air deposition modeling and federal/state controls be instituted for air pollution sources that may be causing or contributing to Buffalo River impairment.]

Municipal and Industrial Wastewater Facilities

Existing municipal and industrial wastewater facility discharges are in general compliance with their State Pollutant Discharge Elimination System permits. These facilities will continue to be monitored and renewed to meet water quality standards with a minimum of secondary treatment for municipal discharges and best available technology and best management practices for industrial discharges.

Monitoring data from these facility discharges will provide a data base for the assessment of specific entry points related to the potential for continuing exceedance of bottom sediment criteria or water quality standards.

Combined Sewer Overflows

Combined sewer overflows are potential sources of contaminants which, based on existing data, are associated with four use impairments of the Buffalo River. The Buffalo Sewer Authority (BSA) collection system consists of sewers that have been constructed over the past 100 years. As in the case of other large cities, the system conveys both sanitary waste and stormwater. The BSA has been engaged in rehabilitating its collection system over the past decade. The activities include a physical survey of the structural condition and operating characteristics of the system, the installation of backwater flow prevention devices to minimize the intrusion of extraneous flow into the system, the repair or replacement of various sewer reaches, pump station rehabilitation and the removal of deposition to enhance sewer carrying capacity.

With the completion of most of the above and based on a State Pollutant Discharge Elimination System permit requirement, model development was initiated by the BSA to identify and evaluate system capacity and possible improvements to maximize flow to and treatment by the wastewater treatment facility to minimize overflows. The initial modeling effort was focused on the main interceptor system.

The combined sewer system model is currently in the initial stage of development by the BSA. Completion and verification of this model will allow the identification of physical or operational system improvements that would minimize overflow occurrence.

If water quality monitoring (conducted as an initial action) indicates the potential for continuing exceedance of bottom sediment criteria or water quality standards, investigations to assess specific contaminant entry points would be undertaken. The data developed in modeling and evaluating the BSA combined sewer system would provide input for these investigations. Upon completion of these investigations, identified system improvements that would result in reducing the potential for exceedance of bottom sediment criteria or water quality standards would be designed, implemented and monitored.

[The BRCC recommends that pollutants in combined sewer overflows be monitored at each outfall to determine total pollutant loading to the river. Further monitoring should be based on priority outfalls. Preliminary monitoring is being undertaken in an overflow study being conducted for the BSA. The BRCC also recommends that system improvements be established based on current and proposed monitoring, maintenance programs, and achievement of pollution loading reductions. The purpose of the current BSA study is to identify potential system improvements. The BRCC urges the use of monitoring data to assess the effectiveness of pretreatment programs. This is currently an element of the BSA pretreatment regulatory program. The BRCC also recommends the expanded use of best management practices, eg. management of road salting, street cleaning, etc. where necessary, and that monitoring data be used to assess the effectiveness of best management practices.]

Other Point Sources

Existing water quality programs consider other point sources, however, should the contaminant sources above not account for potential continuing exceedance of bottom sediment criteria or water quality standards, a focused investigation of other point sources (eg. storm sewers) would be initiated. Remedial design, implementation and monitoring would follow for those specific entry points identified as sources of contaminants related to potential continuing exceedance of bottom sediment criteria or water quality standards.

Fish and Wildlife Habitat

Upon completion of the assessment of fish and wildlife habitat improvement potential, which will be conducted as an initial remedial action, a habitat improvement plan would be developed.

[The BRCC recommends that nesting areas for native waterfowl and shore birds be provided at five representative sites of at least one acre each. The committee also recommends that a survey of current and potential spawning sites for warm water fish species be undertaken and coordinated with a survey of bulkheaded areas and land use along the river. In addition, the BRCC urges the provision of spawning sites as needed to insure a viable warm water fish community, to include viable populations of largemouth bass, smallmouth bass, sunfish, rock bass, yellow perch, catfish and minnows.]

Based on the habitat improvement plan, necessary lands for plan implementation would be acquired. Habitat improvement design would follow, along with implementation, with the exception of those elements dependent upon the completion of bottom sediment remediation. With the completion of the selected alternative for bottom sediment remediation, habitat improvements would be completed and monitored.

Monitoring

In the context of a Remedial Action Plan, monitoring is carried out to determine whether the remedial actions that have been undertaken are achieving the expected environmental improvements. The details of such a monitoring exercise must be linked closely in time, place, and type with the specific remedial measures. They should be designed with the remedial program.

Since a definitive remedial scheme to correct the problems of the Buffalo River cannot be described at this time, a monitoring program cannot be established. However, some general statements can be made about monitoring methods, parameters, and indicators for the impairments defined by the Great Lakes Water Quality Agreement. This information will be useful when the specific monitoring schemes are designed.

Table 7.1 shows, for each of the use impairments known or likely to be occurring in the Buffalo River, a proposed sampling method, parameters to be measured, and indicators of recovery.

TABLE 7.1
MONITORING METHODS, PARAMETERS, AND INDICATORS FOR
USE IMPAIRMENTS DEFINED BY THE GREAT LAKES WATER QUALITY AGREEMENT

Use Impairment	Sampling Method	Measured Parameter	Indicator of Recovery
1. Restrictions on fish and wildlife consumption.	Collection of edible species. Possibly caged fish.	Chemical levels in flesh of fish.	Comparison of levels with guidelines. Removal of advisory by DOH.
2. Tainting of fish and wildlife.	Collection of edible species. Possibly caged fish.	Taste or odor.	No reports of tainting.
3. Degradation of fish and wildlife populations.	Collection of indicator species.	Population estimates.	Populations meet DEC plans for area.
4. Fish tumors and deformities.	Fish collection.	Frequency of tumors and deformities.	1/
6. Degradation of benthos.	Bottom surveys.	Population/ community indices and species count.	1/
7. Restrictions on dredging.	Cores of sediments in navigation channel.	Chemical levels, toxicity, and bio-accumulation.	Comparison with guide-lines. Decision by DEC and EPA to allow open lake disposal.
14. Loss of fish and wildlife habitat.	Habitat survey.	Comparison with DEC management plans.	Habitat consistent with DEC management goals for area.

1/ Indicator of Recovery under development

For some of the use impairments, in this case four and six, there are no simple indicators of recovery. One could say that the system has recovered when the indicators have reached "normal" levels. However, there is no way to establish such normal levels except by expert judgment based on wide experience with relatively clean waters. In addition, the ultimate acceptable recovery will depend to a great extent on public opinion and the cost of remediation. A certain degree of fish tumor incidence above what experts would agree is characteristic of pristine areas, might be acceptable if the cost to obtain this ideal were large.

In cases where there is no clear indicator of recovery that can be agreed on in advance, it might be satisfactory to assure that the indicator has improved with the remediation, or that other system characteristics have improved to a satisfactory state. For example, instead of measuring the benthic population after remediation, it might be better to base a conclusion about whether the remediation has corrected the problem or not on more general indicators such as the state of the overall fish population.

A particular caution should be noted with regard to measurements on fish and wildlife, particularly those ordinarily consumed by humans. These species travel outside the Buffalo River and are likely to be affected by water quality existing outside of the Buffalo River Area of Concern. To determine whether remediation within the Area of Concern has affected fish populations, the use of caged fish suspended in the river may be required.

Because of the difficulties noted above, there is a need for development of surrogate measurements that can be made directly on the sediment or water system, and that will allow estimations of environmental damage to be made. Water quality standards based on chemical analyses and Daphnia toxicity tests are examples of such surrogates. There is need for similar measures and associated acceptance criteria for sediments.

<u>Legislative Recommendations</u> (Prepared by the Buffalo River Citizens' Committee. DEC does not believe that legislative changes are necessary to implement this RAP.)

The RAP generally provides for initial implementation of specified remedial actions under existing statutory authority. The Buffalo River Citizens' Committee believes that two kinds of legislative activity are desirable to assure that the Buffalo River RAP, and other remedial action plans currently being developed by New York, accomplish their objectives. First, a general Great Lakes amendment to the Environmental Conservation Law should be enacted to assure that both the short-and-long-term goals of the Water Quality Agreements are given adequate consideration when the Department is taking actions that affect the areas of concern. Second, implementation of the RAPs should be reviewed periodically for the purpose of determining whether existing laws and regulations are preventing or impeding progress toward eventual elimination of persistent pollutants in the areas of concern. This review should include substantive legal authority, administrative strategies and priorities used in implementing that authority, and budgetary resources allocated to work related to the RAP. This review should include both state and federal programs.

The issue of whether existing legal authority is adequate to solve the pollution problems in the areas of concern is generally not a matter of explicit conflicts between the Great Lakes Water Quality Agreements and particular program statutes. For the most part, existing statutes can be, and have been, used to achieve major reductions in pollution loadings to the Great Lakes ecosystem. However, there are a number of unresolved questions as to how some of those statutes will be interpreted and applied, how discretion will be exercised under them, and how quickly progress can be made in achieving the long-term goals.

The Great Lakes Water Quality Agreements (WQA) establish both short-and-long-term goals for the protection of the ecosystem. The short-term goals are more detailed with respect to objectives such as numerical targets that should be met for concentrations of particular pollutants. The long-term goals are stated in more general terms, as in the provision that the basic purpose of the 1978 WQA is "to restore and maintain the chemical, physical, and biological integrity of the Great Lakes Basin Ecosystem." In pursuit of this goal, the two countries adopted a broad policy that "the discharge of any or all persistent toxic substances be virtually eliminated," and a philosophy of zero discharge.

The 1987 amendments to the Water Quality Agreement define one mechanism designed to move toward zero discharge, the Remedial Action Plans. Annex 2 specifies the conditions that constitute impairment of beneficial uses in the areas of concern like the Buffalo River. Consistent with the ecosystem approach of the WQA, Annex 2 mandates both restoration of the traditional human uses of the resource, such as fishing, swimming, and drinking, along with remediation of conditions that impair the biological integrity of the area. For example, Annex 2 requires the correction of conditions that are degrading populations of phytoplankton, zooplankton, and benthic organisms, even though these conditions might not directly affect present or potential human uses.

Human health effects have often been the primary concern in regulating environmental contaminants, followed by protection of obvious human uses of water resources such as swimming, fishing, and hunting although regulatory actions are also based upon protection of "lower" levels of the food chain or nongame species of fish and wildlife. The problems of factoring economic costs into the decisionmaking process may also become more difficult as control programs move closer the the goal of zero discharge. Pollution abatement often becomes much more costly as higher levels of removal are sought, and the benefits are not immediately realized in enhanced human uses of the resource.

The process of working out satisfactory resolutions to these issues will likely be a long and difficult one. In some areas, zero discharge is already an achievable goal. In others, it may never be technically or economically feasible. Between these extremes lie a large number of decisions that will have to be made in the future about the nature, timing, and desirability of more stringent controls. The Buffalo River Citizens' Committee believes that the decisionmaking process should be guided by a Great Lakes Amendment to the Environmental Conservation Law, providing that the Water Quality Agreements must be taken into account in determining appropriate levels of pollution control in decisions affecting the Great Lakes and their tributaries. As discussed below, this would not involve a major change in the structure or operation of the Department's programs. For the most part, existing statutes permit the Department to take account of the kinds of effects stipulated by the Water Quality Agreements. However, a clarifying amendment would resolve any doubts about the agency's authority to implement the Agreements in areas of possible legal ambiguity. It would also emphasize the importance of making steady progress toward the long-term goals.

The accomplishment of Water Quality Agreement goals are primarily affected by two Departmental programs: the issuance of permits for direct dischargers into surface waters in the areas of concern, and the remediation of inactive waste sites. In addition, both state and federal control programs will require adequate budgetary resources to carry out the activities necessary for full implementation of the remedial action plans.

a. Point Source Discharges. Municipal and industrial discharges affecting the area of concern are currently regulated under the State Pollutant Discharge Elimination System (SPDES). This program is ultimately governed by the federal Clean Water Act, which establishes minimum requirements for state permit administration. The general goals of the Clean Water Act are consistent with the Great Lakes Water Quality Agreements, and in some respects they are more stringent that the WQA. The Act establishes a national policy "that the discharge of toxic pollutants in toxic amounts be prohibited," and also seeks to "eliminate the discharge of pollutants into navigable waters by 1985" (33 U.S.C. sec. 1251(a)). However, this zero discharge goal was not met by 1985, and will not be met on a national basis for a long time if ever. Thus, the basic question concerning the Clean Water Act and the New York SPDES program is whether the regulatory tools provided are adequate to accomplish the long-term goals.

In compliance with the federal Clean Water Act, New York's SPDES program adopts a two-pronged approach to pollution control. It provides both technology-based limitations and water quality standards. In practice, technology-based limitations have been the primary technique for moving toward zero discharge. Since 1983, the Clean Water Act has mandated use of the best available technology economically achievable to produce reasonable further progress toward zero discharge (33 U.S.C. sec. 1311(2)(a)). This standard establishes three primary areas in which administrative discretion may be exercised: (a) When does a technology become "available"? (b) How are economic factors to be weighted under the "economically achievable" standard? (c) What constitutes "reasonable further progress" toward the long-term goal?

To a considerable extent, the answers to these questions are determined by the federal Environmental Protection Agency. Under the Clean Water Act, EPA has the responsibility for developing and revising "effluent limitation guidelines" or general rules defining the appropriate technologies and permissible levels of pollutants for various categories of dischargers. EPA has encountered numerous delays in issuing and updating effluent limitation guidelines. As a result, states like New York that are responsible for issuing permits have had to fill the gaps through the exercise of "best professional judgment" regarding appropriate treatment technologies.

b. Water Quality Limitations. Under the federal Clean Water Act, water quality limitations are designed to deal with situations in which technology-based permit limits are not sufficient to assure safe drinking water supplies, or to support agricultural and industrial uses, or to provide for "the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreation in and on the water" (33 U.S.C. 1312(a)). New York's system of water quality limitations has three major levels of decisionmaking.

(1) Classification. First, stream segments are classified "in accordance with considerations of best usage in the interest of the public" (ECL 17-0301). In adopting stream classification and water quality standards, the Department must consider past, present, and future uses of the stream, including "the disposal of sewage, industrial

wastes, and other wastes" (ECL 17-0301.3.c). It also must take account of "[t]he extent of present defilement or fouling of said waters" (ECL 17-0301.3.d). Thus, streams like the Buffalo River that have historically been used primarily for disposal of effluents and industrial transportation will tend to have lower classifications than other waterways.

The Buffalo River has a "D" classification, the lowest category in the existing system. This means that the river must permit "fish survival" but not necessarily "fish propagation." The Department interprets "fish survival" to include the maintenance of a viable fishery. Under this interpretation, nine of the use impairments defined in the WQA could be regarded either as impairments of the fishery in their own right, or as indicators that an impairment exists. Degradation of fish populations, restrictions on fish consumption, tainting of fish flavor and fish tumors or deformities would all be considered impairments of a viable fishery. Loss of fish habitat, aesthetics and conditions undermining the integrity of lower levels of the food chain such as benthos, phytoplankton, zooplankton, and algae, would be covered by the New York State standards when these conditions served as causes or indicators of an impaired fishery.

In addition, water quality standards may be written to protect "aquatic wildlife". This term includes animals such as mink and fish-eating waterfowl that do not live within the waterbody, but are nonetheless dependent on pure waters. Thus, New York's water quality limitations could be used to remedy use impairments relating to wildlife as well as fish, as defined in the Water Quality Agreements.

There are two use impairments defined by the WQA that are taken into account at the level of stream classification in New York State when determining the "best use" for the particular water body: drinking water restrictions ("A" stream) and bathing restrictions ("B" stream). Extra costs to industry or agriculture and restrictions on dredge disposal do not have a counterpart in the stream classification system. The presence of these conditions would not be considered on a "D" stream like the Buffalo River.

(2) Issuance of water quality standards. The second stage of water quality regulation is the issuance of standards defining permissible levels of contaminants for each class of waters. Standards may have several different bases. Human health is to be safeguarded against specified kinds and levels of risk (6 NYCRR secs. 701.4-701.5). Fish and aquatic life are to be protected with regard to survival, tainting, and bioaccumulation of contaminants on all streams, and fish propagation is safeguarded on streams classified higher than "D" (secs. 701.8-13).

These regulations should provide adequate authority to write standards assuring the protection of healthy aquatic communities at all trophic levels, as required by the Water Quality Agreements. They should also permit the Department to address the problems of pollutant discharges that affect aquatic life indirectly, as in the situation where contaminants adsorb onto particles and accumulate on the river bottom, gradually reaching levels that are hazardous to bottom-feeding organisms. While the Department's legal authority to issue such standards should be adequate, however, the available data may not be. Reliable toxicological data about the effects of different levels of contaminants on the various kinds of organisms that may inhabit a stream like the Buffalo River are frequently lacking. While the Department will use reliable scientific data from any source in updating its water quality standards, the primary initiative for gathering and evaluating data rests with the U.S. Environmental Protection Agency. Under the Clean Water Act, EPA has responsibility for developing water quality criteria "accurately reflecting the latest scientific knowledge" about the health and welfare effects of particular pollutants (33 U.S.C. sec. 1314).

3. Permit limits. The final stage of the SPDES water quality program is translation of ambient water quality standards into permit limits for individual dischargers. In making this determination, the Department takes into account "analytical detectability, treatability, natural background levels, and the waste assimilative capacities of the receiving waters" (6 NYCRR sec. 701.15(b)). Depending upon the weight and interpretation given to these factors in a particular situation, they may produce a permit that authorizes the discharge of persistent toxic chemicals into an Area of Concern. As Table 5.8 of the RAP indicates, there are several industrial dischargers who are currently permitted to release measurable amounts of heavy metals and cyanides into the Buffalo River. Thus, despite major improvements in the quality of water discharged to the Buffalo River, the goal of zero discharge has not yet been achieved.

c. Combined Sewer Overflows. Although they are primarily regulated through the SPDES program, combined sewer overflows pose distinct problems that may require independent legislative consideration. Two key aspects of controlling combined sewer overflows are capital construction and maintenance to assure that there is adequate retention capacity available in the system to handle increased flows during storm events. Funding for both construction and maintenance have been reduced in recent years. The federal construction grants program was restructured in recent statutory amendments, and state operation and maintenance grants have been cut back. The timing of these cutbacks is particularly unfortunate for the Buffalo area, in two respects. Insufficient funding to reduce overflows from the sewer system could well block implementation of the remedial action plan, because it would likely be impractical to clean up in-place pollutants before the sources of further contaminant inputs are stopped. Moreover, the inadequacies of the sewer infrastructure may impede redevelopment. As discussed in more detail in the budget section below, state and federal legislatures should consider restoration of aid programs designed to abate sewer overflows affecting the Areas of Concern designated under the international agreements.

d. Inactive Sites Program. Virtually all of the inactive toxic waste sites that are potential sources of contaminants to the Buffalo River Area of Concern will be addressed through New York's inactive sites program rather than under the federal Superfund. This is a relatively new program. As a result, there are fewer codified standards to govern decisionmaking and relatively greater scope for administrative discretion. The way in which that discretion is exercised may affect implementation of the RAP in two general ways.

Remediation of any given site is a lengthy process, often requiring five years or more from investigation to completion. Throughout the state, and especially in Western New York, there are large numbers of identified sites that are currently in relatively early stages of the investigative process. Thus, sites which have a relatively low priority may not be fully resolved for some years, as evidenced by the Department's goal of completing remediation at all state sites by around the year 2000. However, it will be necessary to resolve the status of at least those inactive sites that are potential sources of significant contaminant loadings to the Buffalo River before any removal or treatment of contaminated river sediments takes place. Thus, the priority of sites affecting the river may be a significant constraint on implementation of the RAP.

The hazard ranking system currently used to establish priorities for site investigation and remediation is heavily weighted toward human health risks, rather than assessing a site's impact on the full range of beneficial uses defined by the Water Quality Agreements. Since many of the sties in the Buffalo River watershed are not near residential areas or sources of drinking water supply, they may receive relatively low priorities in the hazard ranking system. The ranking system is currently undergoing re-evaluation, and it may be modified to incorporate a broader range of concerns. Until the ranking system is revised, it is difficult to project a definite timetable for investigation and remediation of the inactive sites affecting the river.

A second general area in which the Department's exercise of discretion in the inactive sites program may affect the implementation of the RAP is selection of a remedy. This decision involves several interrelated determinations: What are the nature and magnitude of the risks posed by a particular site? What remedial actions are technically feasible and economically achievable? What degree of containment or removal should be required ("how clean is clean")? Depending on the situation at a particular site, answering these questions may require a substantial amount of discretion and professional judgment.

The proposed Great Lakes Amendment to the Environmental Conservation Law would assure that the goals of the Water Quality Agreements are taken into account when these kinds of discretionary decisions are made at particular sites, and also when Departmental policy relating to inactive site remediation is formulated or codified.

Budgetary Recommendations (Prepared by the Buffalo River Citizens' Committee. DEC will describe budget needs on an annual basis in its annual report.)

In order to ensure the long-term implementation of the Remedial Action Plan, current governmental programs must be maintained and new funding sources identified. The state and federal governments must continue their financial commitment to ongoing efforts such as SPDES, inactive waste site program, water quality monitoring program, sediment demonstration project program, non-point source pollution control program, and sewer maintenance program. To accomplish the full objectives of the remedial action plan, new funding initiatives will be required in the following areas:

State Program

1. Increased SPDES permit renewal and enforcement staff along with stream reclassification personnel to ensure the upgrading of the Buffalo River's water quality. Other Areas of Concern of the Great Lakes within New York State's boundaries will also need these increases.

2. Target Bond Act funds for the Area of Concern which will be used for hazardous waste cleanup and site acquisition for public use. The Bond Act expenditures should also be directed to be used to remediate contaminated sediments in the Buffalo River.

3. The state should appropriate needed funds to monitor the condition of New York's Areas of Concern, track plan implementation and coordinate annual reports/plan modifications with community involvement. These appropriations should be tied into an overall Great Lakes Research and Monitoring Program designed to undertake the necessary biological, sediment, water and pollution source monitoring to track the implementation and improvements made in each Area of Concern. The department should be directed to report to the legislature on the scope and cost of such a program. The state should appropriate and develop a revenue program to fund New York's portion of the proposed Great Lakes Protection Fund. This fund, originated by the Council of Great Lakes Governors, could support a portion of New York's Great Lakes research, monitoring and demonstration project efforts under the overall Great Lakes Research and Monitoring Program.

4. The state should provide necessary matching funds with proposed federal dollars to assist in upgrading sewer systems and combined sewer overflows. These funds can be directed to assist local governments in reducing pollution loadings through maintenance and system modification. The appropriation language should stipulate that any increases in system due to development should not result in increases in pollution loadings to waterways.

5. The state should appropriate necessary funds to complete a non-point management plan for the Buffalo River watershed and monitoring other indirect sources, such as airborne toxic

deposition. Specifically, the state should establish funds for air toxic deposition monitoring programs and identification of sources within state boundaries.

Additional funding needs may be identified as the Remedial Action Plan is implemented, and each year's annual report should identify more specific remediation costs.

Federal Program

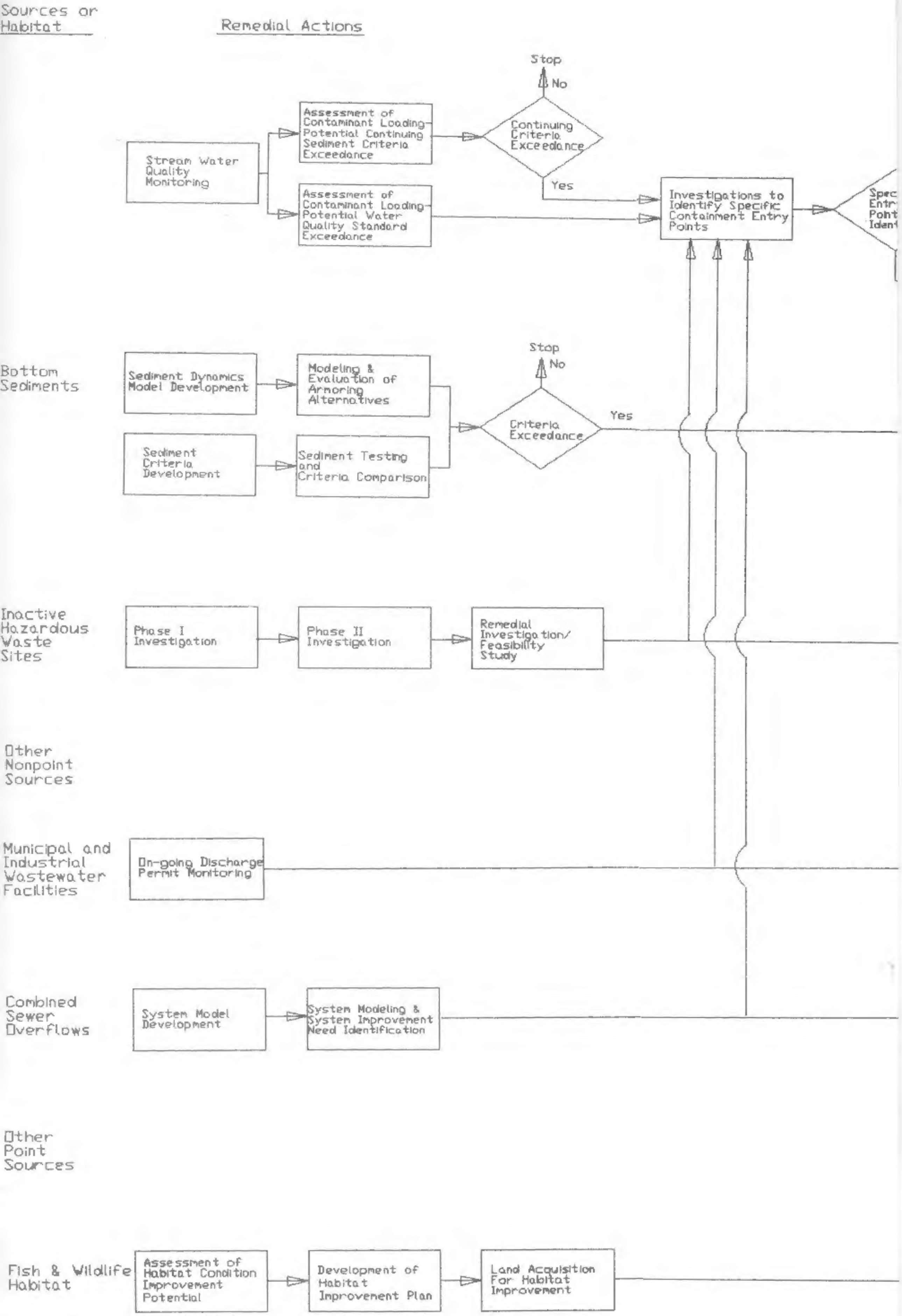
1. Over the next four years, the federal government should fund the full authorized level of the Great Lakes Amendment to the Clean Water Act. In addition, the federal government should re-establish funding levels of federally-supported Great Lakes research institutions. These funds will help provide the necessary coordination under the Great Lakes Water Quality Agreement, implementation of contaminated sediment demonstration projects and generation of background Great Lakes ecological data.

2. The federal government should establish a new type of construction grant program for matching state and community dollars to maintain, improve and expand sewage treatment systems.

3. The federal government should establish an Aquafund program separate from or within the federal Superfund program to address the total remediation costs of contaminated sediments in our bays, sounds, rivers and Great Lakes harbors.

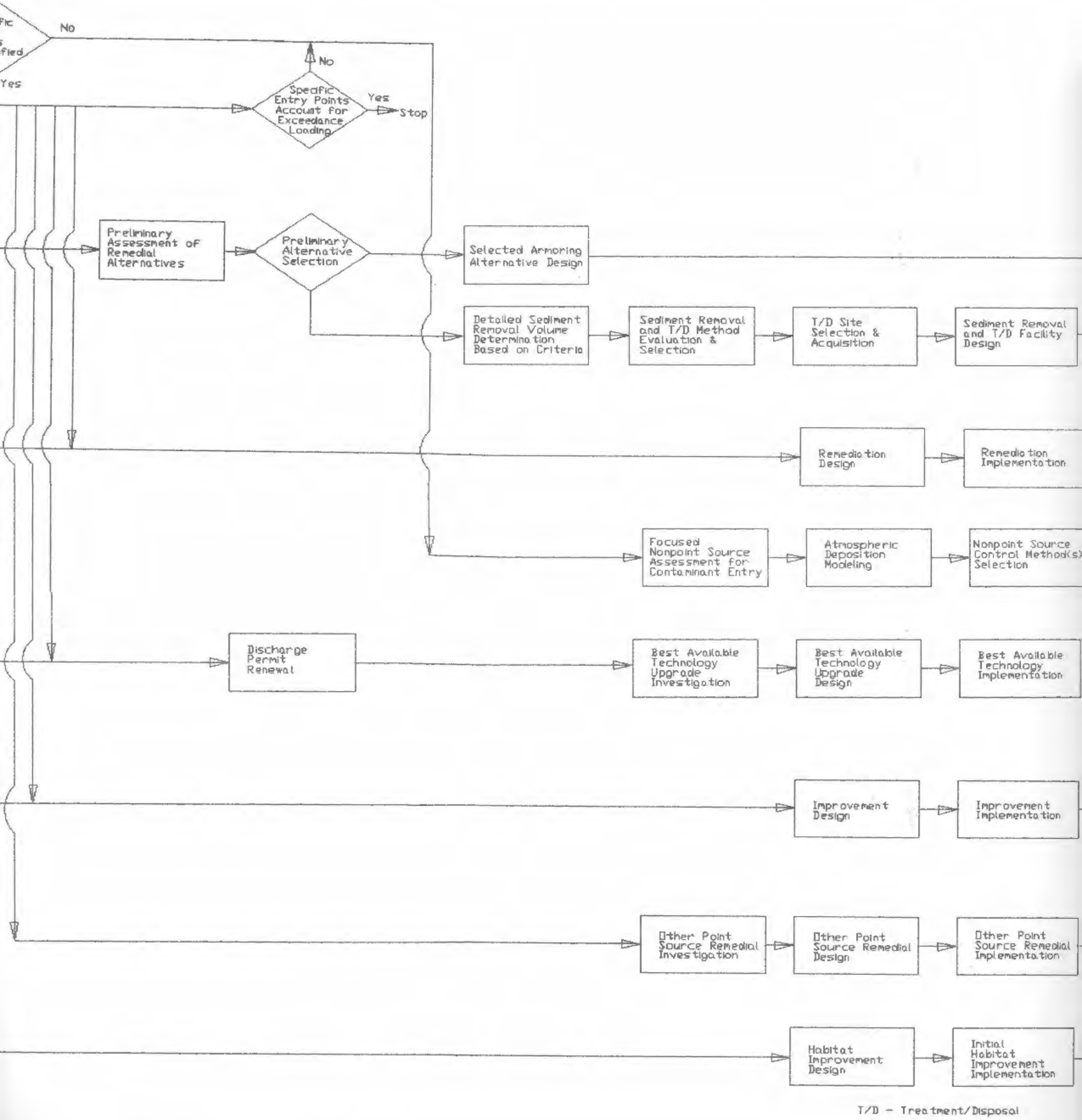
4. The federal government should appropriate additional monitoring/assessment funds to provide for new activities, such as establishment of sediment criteria for toxic contaminants, a species-specimen bank for contaminated wildlife, and an air toxic deposition monitoring network.

Overall, the Environmental Protection Agency needs to direct personnel to integrate their programs with work carried out under the Remedial Action Plan process. This will provide for increased coordination in the annual reports to be issued during the plan's implementation.



Sources or Habitat
Remedial Actions
Stop
No
Assessment of Contaminant Loading-Potential Continuing Sediment Criteria Exceedance
Continuing Criteria Exceedance
Stream Water Quality Monitoring
Yes
Assessment of Contaminant Loading-Potential Water Quality Standard Exceedance
Investigations to Identify Specific Containment Entry Points
Bottom Sediments
Sediment Dynamics Model Development
Modeling & Evaluation of Armoring Alternatives
Stop
No
Criteria Exceedance
Yes
Sediment Criteria Development
Sediment Testing and Criteria Comparison
Inactive Hazardous Waste Sites
Phase I Investigation
Phase II Investigation
Remedial Investigation/ Feasibility Study
Other Nonpoint Sources
Municipal and Industrial Wastewater Facilities
On-going Discharge Permit Monitoring
Combined Sewer Overflows
System Model Development
System Modeling & System Improvement Need Identification
Other Point Sources
Fish & Wildlife Habitat
Assessment of Habitat Condition Improvement Potential
Development of Habitat Improvement Plan
Land Acquisition For Habitat Improvement

Figure 7.1
Remedial Strategy Schematic—Buffalo River



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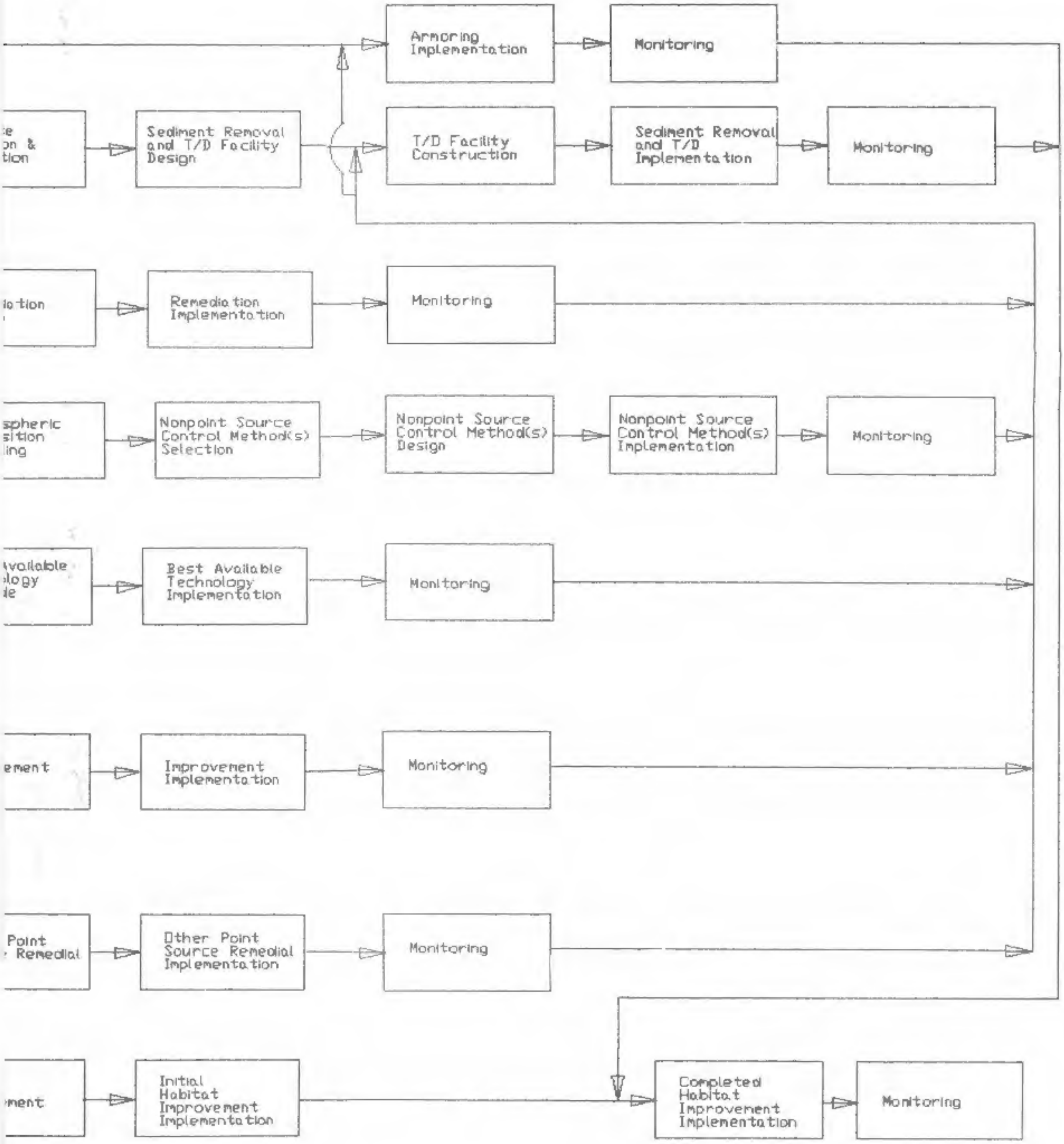


T/D - Treatment/Disposal

CHAPTER 8

COMMITMENTS

Introduction

The remedial strategy outlined in Chapter 7 will require funding far in excess of what is currently available. Therefore, agencies cannot make commitments, at this time, to the complete implementation of this strategy. Such commitments will depend on the availability of funds, and these are likely to be made available only on a step-by-step basis as the investigation and decision process proceeds.

DEC and other responsible agencies have been, and are currently carrying out remediation of environmental problems on the Buffalo River. Since some funding is currently available, certain commitments can be made at this time. Most are for the initial parts of projects identified as required in Chapter 7.

DEC will provide the general coordination for implementation of the remedial strategy. However, participation of other agencies at the local, state, and federal levels is required.

Commitments

An overview of agency commitments describing objectives, time for completion, and responsible agency is shown in Table 8.1. A more detailed description of each commitment follows. Under each commitment the "Next step:" heading denotes those actions needed, to carry out the overall strategy, after completion of the committed actions.

A. Stream Water Quality Monitoring

1. Flow Activated Sampling Station

Establish a flow activated sampling station on the lower Buffalo River.

Efforts are currently underway to establish a flow activated sampling station within the Area of Concern for sample collection during high flow events. It will be necessary for the station sampling design to correct for the influx of Lake Erie water so that true contaminant loadings from the Buffalo River can be determined. A cost estimate for monitoring will also be developed.

Completion date - March 1990
Responsible agency - DEC

Next step: Once the station is operating satisfactorily, it will be used for one season of sample collection. Measurements will also be made at a station at the upper end of the Area of Concern, and the results compared to determine the loading of contaminants of concern from both the upper basin and the Area of Concern.

2. Dissolved Oxygen Measurements

Conduct dissolved oxygen measurements on the Buffalo River. Extensive dissolved oxygen measurements will be carried out under a variety of conditions and at different depths and cross sections. In addition, biochemical oxygen demand measurements will be made to determine upstream, bottom sediment, and other contributors to oxygen demand. An assessment will also be made of the benefits of supplemental water imput from the Buffalo Harbor to the Buffalo River through the Buffalo River Improvement Corporation pumping and transmission system.

Completion date - March 1990
Responsible agency - DEC

Next step: Once the exact nature of the low dissolved oxygen is understood and the contributing causes are identified, remedial measures can be planned.

B. Bottom Sediments

1. Sediment dynamics modeling

Develop requirements for improvements to a sediment dynamics model that would allow sediment scouring and deposition to be accurately predicted under a wide variety of flow conditions, and for alternative dredging scenarios.

This work will involve a thorough review and analysis of previous modeling on the Buffalo River, an assessment of sediment characteristics in the river, and an attempt to formulate both the changes required in current mathematical models and the detailed requirements for measurements of physical properties of bottom sediments needed to perform the modeling. A cost estimate will also be prepared.

Completion date - March 1990
Responsible agency - DEC

Next step: Once the above activities have been completed, a contract (dependent upon NYS Division of Budget approval) can be let for the work of producing detailed predictions of sediment scour and deposition under a variety of conditions. This will produce information necessary for an assessment of the feasibility of remediation through sediment deposition and armoring.

2. Criteria Development

Develop methods for determining sediment criteria that have scientific validity.

EPA has been working for several years on developing and validating tests and associated acceptance criteria that would allow decisions to be made relative to the likely environmental impacts of contaminated sediments. This work will be brought to a conclusion with a report on recommended tests and criteria.

Completion date - ?
Responsible agency - USEPA

Next step: Once a criteria methodology has been developed by EPA, DEC will apply this methodology to the Buffalo River sediments. Funds to support this could come from a demonstration project under the Clean Water Act, Section 118. It would include both the development of site specific criteria, and actual testing of the bottom sediments.

C. Inactive Hazardous Waste Sites

1. Phase I Site Investigations

Conduct Phase I investigations involving existing data accumulation and assessment.

The accumulation and evaluation of existing data to assess contaminant conditions at each site in the Buffalo River basin is being completed by DEC.

Completion date - March 1990
Responsible agency - DEC

Next step: Once Phase I investigations are complete the conduct of Phase II investigations, which include preliminary field studies to fill data gaps to complete the initial site assessment, can be scheduled.

2. Phase II Site Investigations

Conduct Phase II field investigations to fill data gaps to complete initial site assessments.

Phase II investigations are underway at two sites (Allied Chemical and MacNaughton-Brooks) and are scheduled for seven additional sites (Lancaster Reclamation, Town of Marilla, Land Reclamation, Old Land Reclamation, HiView Terrace, Donner-Hanna Coke and Lehigh Valley Railroad).

Completion date - March 1990
Responsible agency - DEC

Next step: Once Phase II site investigations are complete, the sites will be ranked and determinations of need for the conduct of Remedial Investigation/Feasibility Studies (RI/FS) will be made. Once an RI/FS is determined to be required, implementation action can be initiated under a DEC Consent Order by the responsible party or directly by DEC in the absence of a known responsible party.

3. Remedial Investigation/Feasibility Studies

Conduct Remedial Investigation/Feasibility Studies to define contaminant pathways and assess alternative remedial measures.

Remedial Investigation/Feasibility Studies are underway at two sites (Madison Wire and Buffalo Color).

Completion date - March 1990
Responsible agency - DEC

Next step: Once Remedial Investigation/ Feasibility Studies are complete, site remedial measures can be designed.

D. Municipal and Industrial Wastewater Facilities

Discharge Permit Monitoring and Renewal

Continue discharge permit monitoring to achieve compliance with secondary treatment for municipal discharges and best available technology and best management practices for industrial discharges.

DEC reviews self-monitoring reports from discharges, inspects facilities in operation and independently samples effluent to check on the validity of self-monitoring data. Significant violations of permit conditions trigger compliance or enforcement measures.

Completion date - On-going
Responsible agency - DEC

Next step: As the end of the five year term for each existing discharge permit approaches, each permit will be reviewed and reissued to meet water quality standards and with the application of the technology requirements applicable at the time of renewal.

E. Combined Sewer Overflows

Combined Sewer System Modeling

Evaluate the combined sewer system model currently under development to assess its ability to reflect sewer system response to various storm events and system operation plans.

An evaluation of initial model development and testing will be undertaken along with additional system monitoring to verify the modeled system response. Model adjustment and refinement will be made as required.

Completion date - March 1990
Responsible agency - BSA

Next step: Once model development and testing is completed, selected simulations will be made to assess system conditions and alternative operation plans to minimize overflows. Once the exact nature of potential system modifications is defined, remedial measures can be planned.

F. Fish and Wildlife Habitat

Habitat Improvement Potential

Develop plan to assess fish and wildlife habitat conditions and improvement potential.

Habitat loss impairs beneficial uses such as fishing and observing wild birds and animals. The combination of dredging and bulkheading on the Buffalo River has substantially reduced fish habitat by eliminating many productive shallow waters and wetlands. This plan will specifically identify the work to be undertaken to assess the existing habitat conditions both aquatic and terrestrial and to identify potentials for habitat improvement.

Completion date - March 1990
Responsible agency - DEC

Next step: Once the plan for assessment is completed a contract (dependent upon NYS Division of Budget approval) could be let to accomplish the work. A habitat improvement scheme could then be developed which would lead to site acquisition to preserve habitat improvement potentials.

TABLE 8.1
BUFFALO RIVER REMEDIAL ACTION PLAN
COMMITMENTS

Objective	Completion Date	Responsible Agency
A. Stream Water Quality Monitoring		
1. Establish a flow activated sampling station	March 1990	DEC
2. Measure dissolved oxygen	March 1990	DEC
B. Bottom Sediments		
1. Develop requirements for sediment model improvements	March 1990	DEC
2. Develop methods for determining sediment criteria		EPA
C. Inactive Hazardous Waste Sites		
1. Conduct Phase I site investigations	March 1990	DEC
2. Conduct Phase II investigations . Allied Chemical . MacNaughton-Brooks . Lancaster Reclamation . Town of Marilla . Land Reclamation . Old Land Reclamation . HiView Terrace . Donner-Hanna Coke . Lehigh Valley Railroad	March 1990	DEC
3. Conduct Remedial Investigation/Feasibility Studies . Madison Wire . Buffalo Color	March 1990	DEC

TABLE 8.1 (Continued)

Objective	Completion Date	Responsible Agency
D. Municipal and Industrial Wastewater Facilities		
Continue discharge permit monitoring	On-going	DEC
E. Combined Sewer Overflows		
Evaluate combined sewer model	March 1990	BSA
F. Fish and Wildlife Habitat		
Develop plan for assessment of habitat conditions and improvement potential	March 1990	DEC

CHAPTER 9
TRACKING BUFFALO RIVER RAP IMPLEMENTATION

Introduction

DEC will produce annual reports that show the progress on the remediation to date and the firm commitments that can be made for future activities. In addition, during the course of remediation, DEC may find it necessary to make major revisions to the RAP. New facts will be discovered and other factors may arise that will dictate changes in the strategy either through major changes in the proposed series of steps and decision points, or through the addition of remediation paths not included in the original RAP. Revisions to the RAP will also be required to satisfy the phased submission to the International Joint Commission called for in Annex 2 of the Great Lakes Water Quality Agreement. DEC plans to continue the public participation that has been important in the development of the original RAP in preparing both the annual report and revisions to the RAP. Table 9.1 shows the relation between the state budget cycle and other activities to track and report on remediation.

Annual Report

To insure that the Remedial Action Plan is dynamic, an annual progress report will be issued during May of each year. This report will summarize the results of remedial investigations and research, list accomplishments in the previous fiscal year, describe commitments for the current fiscal year, and provide necessary revisions to the plan. During June the report will be the subject of a public meeting at which there will be opportunity for the interested publics to comment on the specifics of the

TABLE 9.1
RELATION BETWEEN STATE BUDGET CYCLE AND ANNUAL REPORT AND RAC ACTIVITIES

	JAN	F	M	A	M	J	J	A	S	O	N	D
BUDGET PROCESS		Governor's Budget		Budget Passed by Legislature				DEC White Papers		DEC Budget to Gov.		
DEC						Annual Report -Accomplishments in previous FY	Public Meeting					
Remediation Advisory Committee			-Discuss recs. for next FY -Plan involvement for next FY -Discuss federal budget for next FY						-Draft recs. for next FY			-Review progress -Review federal budget -Revise recs. for next FY

← State budget year begins/ends (A)

actions planned, and on the overall strategy.

Plan Updates

It is expected that major changes to the RAP will be required in the future, even though minor changes in the RAP may be reported routinely in the annual report. For example: new information may become available during investigations carried out as part of the remedial strategy; other activities carried on outside the RAP, such as major changes in land use along the river, or changes in the use of the river itself may alter the setting of the RAP; and new research and development findings related to remediation may suggest changes in strategy.

As the need for these changes becomes apparent, and on the advice of the Remedial Advisory Committee (see below) DEC will prepare such revisions with active public participation in the process. The revisions proposed will also be submitted to the International Joint Commission and will cover the requirements for staged reporting under the Great Lakes Water Quality Agreement.

Remedial Advisory Committee

A Remedial Advisory Committee (RAC) will be formed to advise and assist DEC in its implementation of the RAP. The RAC will be representative of concerned groups outside of DEC that have an interest in the Buffalo River. It will advise DEC on both annual reports and RAP updates.

The RAC will meet with DEC staff at least three times each year. The participants at these three meetings will:

March Meeting: Discuss DEC commitments for the next fiscal year based on the Governor's budget, and the likely legislative decisions on the budget. Begin discussion of remedial recommendations for the next plus one fiscal year. Discuss federal budget for next federal fiscal year. Provide input to the Annual Report. Committee members will plan their involvement through the next fiscal year to help move the remediation forward.

August Meeting: Review results of public meeting and begin to draft recommendations for remediation in the next fiscal year.

November Meeting: Review progress, review federal budget, begin discussion of federal budget for next federal fiscal year, and complete recommendations for next fiscal year.

The RAC will advise DEC on amendments to the RAP and will recommend the need for major revisions and submittal to IJC. The RAC will be appointed in late 1989 by the Commissioner of DEC.

Twelve RAC members will be selected to represent a balance among:

Elected and appointed government officials;
Public interest groups (non-economic interest)
Economic interest;
Private citizens (non-economic interest).

In addition to RAC members, agencies at all levels of government will be asked to participate and provide input in RAP implementation as needed.

Long-Term Data Management

During the course of preparation of the Buffalo River RAP, the BRCC developed a computerized database that included a wide variety of information related to environmental conditions in the river, industrial and municipal pollutants, and hazardous waste sites along the river. It is DEC's intent to use this database as the foundation for a comprehensive, long-term, computerized management system for the Buffalo River that will be maintained by DEC for use in the remedial process.

This database will be keyed to geographical coordinates and will be available for public distribution. The development of the system will begin when DEC has obtained the necessary hardware and software.

CHAPTER 10
PUBLIC PARTICIPATION

Introduction

Public participation has been an integral part of the RAP process. To implement the RAP and achieve its goals, all responsible jurisdictions need to be involved in developing the plan. From the beginning, the interested and affected public was identified along with its concerns and ideas. The community members and the elected officials became informed and involved in the planning process and built support for the Buffalo River RAP.

The International Joint Commission calls for an ecosystem approach in developing the RAP, as well as extensive public involvement. The RAP integrates a variety of existing programs within the DEC into one plan. By reaching out to local and regional researchers outside the Department, other existing scientific knowledge and professional opinions regarding the Buffalo River were identified.

DEC's commitment to public involvement planning, together with the Buffalo River Citizens' Committee efforts to build a constituency for the river, resulted in an innovative partnership for public participation in developing the Buffalo River RAP. This chapter provides a detailed description of the public participation process and how public input contributed to the RAP process.

History of the Public Participation Process

In November of 1986, eleven environmental, community, sportsmen and local government representatives called upon New York State Department of Environmental Conservation former Commissioner Henry G. Williams to establish a Citizen Advisory Committee to assist the Department in the development of the Buffalo River RAP.

In March 1987, Commissioner Williams appointed a 21-member Citizen Advisory Committee called the Buffalo River Citizens' Committee (BRCC). The membership included the above representatives. DEC then hired a Citizen Participation Specialist to implement the public participation progam and coordinate the activities of the BRCC. The mission of the BRCC was to assist the DEC in developing the Buffalo River RAP. In addition, the BRCC was interested in building a constituency for the river.

In August 1987, the new DEC Commissioner Thomas C. Jorling renewed the commitment to the Buffalo River RAP process. A Steering Committee consisting of DEC staff members and Buffalo River Citizens' Committee chairpersons was established. The Steering Committee provided effective communication between the Department and the Committee. The Steering Committee created the project workplan.

Buffalo River Citizens' Committee representatives and DEC staff worked cooperatively to organize technical information needed to prepare the plan; create public awareness and support for the Buffalo River RAP; and comprehensively review in-process material.

The Public Participation Plan Process

In general, the amount of public participation is regulated by the community needs as well as the Department's resources. Planning for public participation can effectively identify and incorporate public input needs. Early in the RAP development, a plan was developed to conduct public participation. It identified the communication objectives, the interested and affected public, the information exchange needs and the activities to be carried out. Public participation activities were designed to coincide with the tasks of the project workplan. To document the public participation that took place during the RAP development, the following outline lists (a) the communication objectives, (b) the public contacted during the RAP process, (c) the information that was exchanged among DEC, BRCC, and the public, and (d) information materials, meetings and events related to the RAP.

Buffalo River RAP Public Participation

I. Communication Objectives
   A. To involve the interested and affected public in the Buffalo River RAP development process.
   B. To build public support for and community ownership of the Buffalo River RAP.
   C. To utilize the resources of the community.
   D. To build a working relationship between the Buffalo River RAP Citizens' Committee and DEC.
   E. To maintain communication necessary for an ecosystem perspective in developing the Buffalo River RAP.

II. Public Reached
   A. Government Agencies and Elected Officials
      1. Local - Mayor, Councilmen, Planning Department*, Waterfront Planning Board, Board of Education.
      2. County - ECDEP*, EMCs, SWCD, County Executive.
      3. State - DEC, DOH, DOT, NFTA*, Dept. State Coastal Management Program.
      4. Federal - USEPA, USACOE, USF&W, USSCS.
      5. International - IJC.
   B. Interested Public Groups and Organizations

1. Community and Civic - League of Women Voters, Rohr Street Block Club*, Valley Community Association, Frontier Democratic Club, Presbytery of Western New York*, Scouts, Industrial Heritage Committee, NYPIRG, Citizens Alliance*, United Auto Workers Local 774*.
2. Environmental - Great Lakes United*, Audubon Society*, Adirondack Mountain Club*, Help Eliminate Lawn Pesticides*, Citizen Action*, Friends of Olmsted Parks*.
3. Sports Interests - The Walleye Association*, Buffalo Harbor Sailing Club, The Rowing Club, The Western New York Gamefish Conservation Club, NYS Conservation Council*.

C. Academics and Researchers - SUNY at Buffalo*, SUCB*, Great Lakes Research Consortium, Roswell Park Memorial Institute, Science Museum.

D. Interested small business and industry within the Area of Concern, including marinas.

E. Other
1. Other RAP Groups - In NYS, other states and the Province of Ontario.
2. General public.

* denotes BRCC representation

III. Information Exchange - (Note: The information exchange listed below among DEC, the BRCC, and the public was carried out through the activities listed in Part IV.)

A. Information given to the public:
1. Goal statement, time frame, background and details about the RAP project.
2. Ways to participate in the RAP process.

3. Progress of RAP development and the BRCC activities.
4. List of impaired beneficial uses and recommendations being considered.
5. Supporting data and existing information on the Buffalo River.
6. A draft RAP document.

B. Information received from the public:
1. Opinions regarding the problems of the river and restorative goals for the river's future.
2. Additional data and facts to support the RAP, as well as corrections to the data.
3. Input on the impaired beneficial uses, the Area of Concern, and recommended solutions.
4. Comments on draft RAP. (Public comment to be received in 1989).
5. Evaluation of communication efforts.

C. Between DEC and the BRCC - Most of the direct discussion between DEC and the BRCC took place at Steering Committee meetings. DEC and the BRCC shared information, exchanged ideas, and worked cooperatively to carry out the tasks needed to develop a RAP, including formulating and reviewing a:
1. Goal statement.
2. Workplan and time frame.
3. Public participation plan.
4. Computerization data base and summaries of existing environmental and source data.
5. Statement of impaired beneficial uses.
6. Document outline.
7. Compilation of draft chapters.

IV. Information Materials, Meetings and Events

A. Written Materials - <u>In addition to the written materials listed above</u>, DEC and the BRCC produced:

1. Mailing lists for monthly meetings and the newsletter.
2. A quarterly newsletter - provided information on RAP progress, subcommittee work, and upcoming public outreach activities.
3. An informational brochure for general distribution.
4. A series of Buffalo River Week materials including news releases and special activity flyers and brochures.

B. Meetings - Meetings were a major form of communication among DEC, the BRCC, and interested public. Below is a list and brief description of the meetings held:

1. Public Meetings - In 1987 to introduce the RAP process and receive public input on the problem; and in May 1989 to comment on the draft RAP.
2. BRCC Meetings - Held monthly to report progress of subcommittees and the Steering Committee, review data and in-process drafts.
3. Steering Committee Meetings - To develop the workplan and review all in-process material.
4. Subcommittees - Working groups of the BRCC for Public Outreach, Database/Remedial Action, and Long-Term Goals/Land Use.
5. Biota Workshops - Provided data and professional opinion of the scientific community related to biota research on the Buffalo River.
6. Land Acquisition Workshop - For input on locations along the river to recommend for purchase for public access under Bond Act funds.
7. Buffalo Sewer Authority Workshop - For BRCC members to better understand the combined

sewer overflow system and address specific concerns.

8. Public Workshops - held in April 1989 to present the draft Buffalo River RAP and discuss related issues prior to public comment.

C. Events and Presentations - These activities were directed toward increasing public awareness of the Buffalo River and the RAP development.

1. Buffalo River Boat Tour - To facilitate information exchange between DEC and the BRCC and gain a first-hand view of the river in its current state.
2. Theatre Show - Public outreach activity about pollution in the Buffalo River.
3. Auto/walk tours of the river.
4. Bumper sticker distribution.
5. RAP Slide-Tape Show - History and background of the RAP project presented to over 25 community organizations. This project was a major public outreach tool. A second slide-tape show was produced in March 1989 to present the RAP.
6. Buffalo River Week, May 1988 - Officially recognized by state, county and local officials. The week's activities included a riverside cleanup, fishing and coloring contest.
7. Panel Exhibit - Displayed at the Great Lakes Fishing and Outdoor Expo, DEC office and related local meetings.
8. Buffalo River Regatta - Held in August 1988.

Key Areas Where Public Input Has Contributed

Public participation took place in all the key tasks performed to complete the RAP. While most of this input was provided though the BRCC and through the contributions of the subcommittees, the series of biota workshops and public meetings are other key activities.

Key Contributions of the BRCC

The BRCC has been instrumental in the development of the RAP and the implementation of public outreach activities. These activities have maintained the continued involvement and interest of the organizations represented on the BRCC and built general public interest and support for the RAP in the community.

The BRCC activities focused around three subcommittees: the Database and Remedial Action Subcommittee; the Land Use and Long-Term Goals Subcommittee; and the Public Outreach Subcommittee. Interested publics not represented on the BRCC were involved in the RAP process by participating directly on subcommittee activities, attending open monthly meetings, or receiving newsletters. Anyone with useful information related to the RAP was encouraged to share it with DEC or the BRCC. Below is an overview of the contributions by each subcommittee to the RAP process.

Database and Remedial Action Subcommittee. This subcommittee included a number of university representatives and others with technical expertise. They explained scientific information and data to the full committee and met frequently with DEC technical staff to discuss RAP related issues.

A major project of this subcommittee was a computerized data base of source data and other environmental data related to the Buffalo River watershed. The information for the database was compiled by subcommittee members from existing data in DEC files and documents. They were able to familiarize themselves with the material and share this information with the full BRCC. This base was used to summarize source data for the RAP document. It will also be a useful resource tool for DEC and the universities.

This subcommittee assembled maps useful for the RAP, sponsored the Buffalo River auto/walk tours, researched remedial technologies, and communicated with the Buffalo Sewer Authority (BSA). The subcommittee and the BSA organized tours of the wastewater treatment facility and held workshops to describe the combined sewer overflow system and maintenance procedures.

Land Use and Long-Term Goals Subcommittee. The major contribution of this subcommittee is the section of the RAP on land use recommendations. The subcommittee was concerned with examining existing plans to develop the Buffalo waterfront (which include the river). They identified environmental concerns that need to be recognized before some desired uses could be implemented.

In researching ways to acquire more public access to the river, the subcommittee submitted recommendations to the DEC on suitable sites that could be purchased for public access along the river through Bond Act funds. The subcommittee sponsored a workshop to receive input from the public on which sites to recommend. This process contributed to the development of a detailed proposal for a park and discovery center along the river.

This subcommittee was also concerned about the long-term goals for the river and the use of ecological indicators to track the RAP's effectiveness. They submitted a checklist of goals and ideas to the Steering Committee to consider in writing the RAP.

Public Outreach Subcommittee. This subcommittee has been instrumental in implementing all the public outreach activities to date. Working closely with the DEC Citizen Participation Specialist, this subcommittee arranged public meetings, developed a slide-tape show and a distribution scheme for its presentation, carried out Buffalo River Week activities, designed a RAP brochure and bumper sticker, published a quarterly newsletter, sponsored a theatre presentation and communicated periodically with the media and local elected representatives.

The subcommittee utilized the resources of the full Committee and its representative groups to carry out these activities. This networking strategy was important for building a constituency for the river that previously did not exist.

Between January and May 1988, the slide-tape show was seen by 2,000+ people from over 25 community groups and organizations. The show covered the environmental and industrial history of the river, the efforts to restore the river through the RAP process, and the opportunity for public involvement. The presentor of the show, usually a BRCC member, distributed RAP brochures and bumper stickers, collected names for the mailing list, and completed an evaluation form. The slide-tape presentations were helpful in setting the stage for support of Buffalo River Week, which was planned in conjunction with New York State's Water Week. Local, county, and state officials took part in proclaiming Buffalo River Week. The week's activities included a student coloring and word game contest, a river shoreline cleanup, a fishing contest, state, county and university displays, and a Bison baseball game. Community involvement was further fostered with a regatta on the Buffalo River. Although measuring the increased awareness and support of the RAP is difficult, it was evident that new people were reached through these events.

Biota Workshops

A series of workshops titled, "Biota Research Related to the Buffalo River", was held to exchange information and make use of the resources of the scientific community. Local and regional scientists from university and government centers provided environmental data and professional opinion related to biota aspects of the Buffalo River. The participants provided information on the river impairments dealing with aquatic biota and discussed specific research that could lead to further understanding of the river's problems.

Public Meetings

Three public meetings were held in the community prior to defining the river's problems. DEC and the BRCC presented an overview of the RAP process and described how the interested public could participate through the BRCC activities. The public was asked to comment on (1) what desired uses they would like for the Buffalo River in the future (2) what they felt the barriers or problems were that prevented those desired uses, and (3) what the solutions to those problems might be. A seven-page summary of the public comments provided DEC and the BRCC with a range of public opinions and concerns as well as a list of how people would like to be included in the project.

Public review of the draft RAP occurred in April and May 1989, with three workshops and two public meetings. Over 1000 forty page draft summaries were distributed to the community in March 1989. Eighty-five people attended the workshops which were designed to explain the RAP in detail and provide the opportunity for discussion and questions about the RAP. Twenty-nine organizations or individuals submitted comments which were considered in the development of this final RAP.

Future Public Participation

Future public participation will focus through the Remedial Advisory Committee (RAC) and the annual public meeting as described in Chapter 9. DEC will also cooperate in supportive RAP activities sponsored by local groups such as the Friends of the Buffalo River, Inc. and the Buffalo River Study Group. As a result of the RAP process, these two organizations were formed with BRCC members' leadership to maintain community interest and involvement in the RAP and other river related issues. A brief description of these groups are below.

- The Friends of the Buffalo River, Inc. (FBR) is a nonprofit corporation whose goal is to promote, preserve and protect the River, its natural and historical environment. The group has three major goals: to oversee land use development that meshes public access, ecological integrity and economic viability; to develop a public outreach effort that will provide opportunities for the surrounding community to enjoy and learn about the river; and to support RAP implementation.

- The Buffalo River Study Group is currently affiliated with the State University College at Buffalo and the

State University of New York at Buffalo. The group is designed to sponsor research, guest lectures, course development and other activities related to the Buffalo River. Their projects will involve technical aspects of the river, archiving information, creating computer data bases, and the social/political aspects of the RAP process. The Buffalo River Study Group will coordinate their efforts with the FBR, interested government agencies and private citizens.

CHAPTER 11
LAND USE

(This Chapter was prepared by the Buffalo River Citizens' Committee)

Introduction

Some people say we must sacrifice a clean environment for a thriving economy and the jobs and prosperity it brings. But this old-fashioned viewpoint is being challenged. There is a growing recognition that economic development and environmental restoration can go hand in hand. As Baltimore and other cities are showing, a revitalized waterfront can greatly contribute both to a community's economy and quality of life.

The Buffalo River presents an exciting opportunity to link environmental clean-up with economic revitalization. In this final chapter of the Buffalo River RAP, it is recognized that new land use and revitalization efforts in the Buffalo River basin can and must be compatible with and contribute to the restoration of the river and its ecosystem.

First, an overview of the basin's industrial history is presented, followed by a description of current land use patterns in the area of concern. Then, an examination of existing land use plans provides a perspective on the overall community vision for the future of the Buffalo River. Key political entities involved in land use planning are identified. Finally, general and specific land use recommendations developed by the Buffalo River Citizens' Committee (BRCC) are described. These recommendations are designed to ensure that clean-up of the Buffalo River, and revitalization of the lands along the river's course are closely tied together.

History

Buffalo exists because of activities associated with the Buffalo River. The City's location, historic development, and present qualities derive from the possibilities the river offered during the time when Buffalo was established and growing. Use of the Buffalo River changed a wilderness into an industrial city, and changed the river into what it is today.

In the period before the development of the U.S. railroad system, the run of the Great Lakes, from the eastern shore of Lake Erie above Niagara Falls to the western shore of Lake Superior, provided prime access into the heart of a rich and untouched continent. The mouth of the Buffalo River provided the best harbor available at the eastern limit of the Great Lakes' navigable reach.

During the early 1800's, the Erie Canal was extended to the Buffalo River, making the sheltered waters of the river the foundation for Buffalo's growth as a major world center for transhipment of raw materials, as well as agricultural and manufactured products. While railroads and highways have grown to become the links for new modes of transportation, the river's role in transportation remains. Commercial vessels still use the river.

The first river-based indigenous industries were mills built to utilize the river's water power. Later, more massive industrial operations on the Buffalo River grew out of the river's development as a transportation link. In the Buffalo River basin, raw materials from the North American continent were brought together with a steadily growing supply of labor to fuel industrial development.

During the second half of the nineteenth century and the first half of the twentieth century, manufacturing facilities grew along the banks of the Buffalo River, turning grain, lumber, iron, coal, and petroleum into a wide variety of semi-finished and finished products. Flour mills, timber processing, steel plants, oil refining, ship building, and petrochemical operations lined the banks of the river. For these industries, the Buffalo River was not only a transportation link between suppliers and markets, but was also a source of necessary fresh water, as well as a receiver of industrial waste by-products.

As industrial development proceeded along the banks of the Buffalo River, neighborhoods grew up near the industrial facilities. These neighborhoods, including the First Ward and The Valley developed into stable communities inhabited largely by immigrant workers employed at the nearby industries. During the 1940's and 1950's, the dramatic rise in blue collar wages improved the standard of living for industrial workers in the Buffalo River basin.

Since the 1950's, as many heavy industrial, manufacturing, and petrochemical facilities have left the Northeast, and as transportation patterns changed with the advent of the St. Lawrence Seaway system, much of the industrial and commercial activity which characterized the earlier Buffalo River has ceased. The people and neighborhoods in the Buffalo River basin have suffered from the serious economic decline associated with this deindustrialization process. The Buffalo River remains, however, with some still viable industrial activity scattered along its banks, amid open spaces, inactive hazardous waste sites, and unused industrial structures.

The physical characteristics of the river have also changed through time. Appropriate future use must confront the manner in which past use has altered the Buffalo River and its surroundings. The first Europeans to see the river saw a meandering stream, important to the life cycles of fish, birds, and animals, and an integral part of the way of life for Native American Indians who hunted, trapped, and fished in the area. During the Village of Buffalo's earliest days, a sand and gravel bar at the mouth of the river was removed, employing the relatively simple technical means of the period, and the mouth of the river was shifted south. Later, as the means became available and industrial development required such efforts, the river was dredged and channelized, turning basins were built, and banks were bulkheaded. Each of these changes increased the suitability of the river for the very particular industrial activities along its banks.

As industrial activities increased along the Buffalo River, so did the discharge of industrial wastes into the river, and the pollution of its banks and bottom sediment. Ultimately, the growth of industry along the river overwhelmed the natural flow capacity available from the watershed. Beginning in 1968, the Buffalo River Improvement Corporation began pumping up to 120 million gallons per day of water from Lake Erie for use by industrial facilities along the Buffalo River. Thus, an important part of the River's flow became water piped in from Lake Erie to provide industry with the relatively clean water no longer available from the River itself. As industrial activity decreased in the 1980's, the amount of water pumped into the river has also decreased, and today the BRIC supplies about 18 million gallons per day to the river.

Existing Land Use in the Buffalo River Area of Concern

The current land use pattern in the Buffalo River area features a large number of run-down buildings, combined with junkyards and vacant land littered with trash, which cause the area along much of the river to look like an industrial wasteland. A closer look shows that real opportunities exist for future revitalization.

Most of the City of Buffalo's land area along the Buffalo River is zoned to allow industrial activity. However, aspects of Buffalo's zoning law allow residential and commercial uses in some parts of industrial zones. Hence, residential, commercial and industrial uses along various portions of the Buffalo River area are permitted by the city's zoning system.

Most of the property near the Buffalo River is currently being used for industrial, manufacturing, and transportation operations, or it is vacant (Figure 11.1). Various facilities along the river are involved in the following activities:

- flour milling
- cereal and grain processing
- grain transportation and distribution
- cement distribution
- furniture making and refinishing
- metal recycling (mainly junked automobiles)
- dye manufacturing
- tire recycling
- oil storage and dehydration
- sulfuric acid production

Figure 2.3 in Chapter 2 shows the location of major industrial and manufacturing facilities along the Buffalo River.

Although most of the land adjacent to the Buffalo River is either vacant or used for industry and transportation,

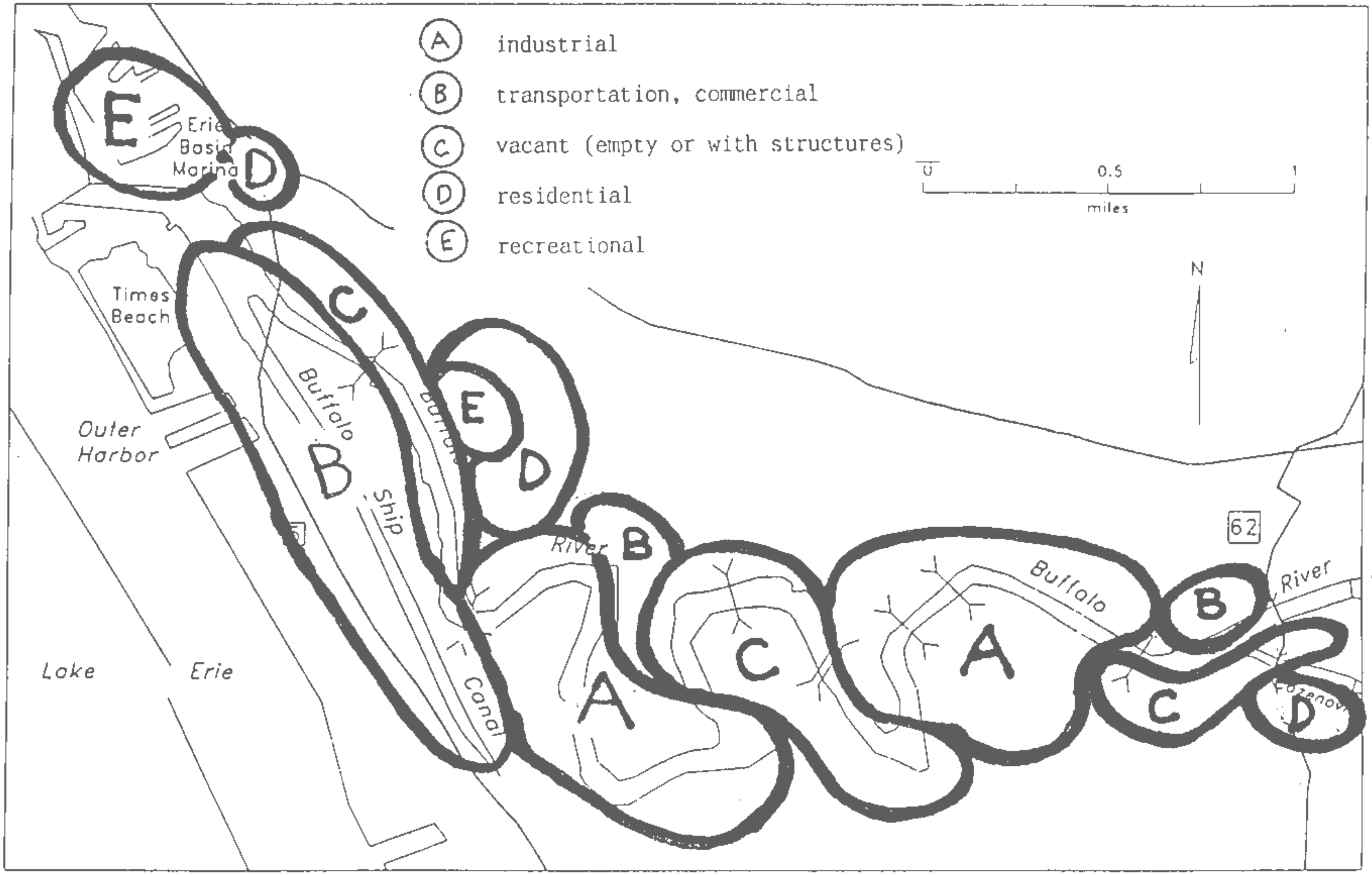


Figure 11.1 - General distribution of current land use along the Buffalo River (compiled with information from the Draft Buffalo Waterfront Masterplan, 1987)

there are many residential neighborhoods in the Buffalo River area. Within the City of Buffalo, these neighborhoods include the First Ward and The Valley. While they have been hurt by the economic decline associated with the shut-down of industrial facilities along the Buffalo River, they are still home to people who would benefit from restoration of the river and revitalization of the lands near the river.

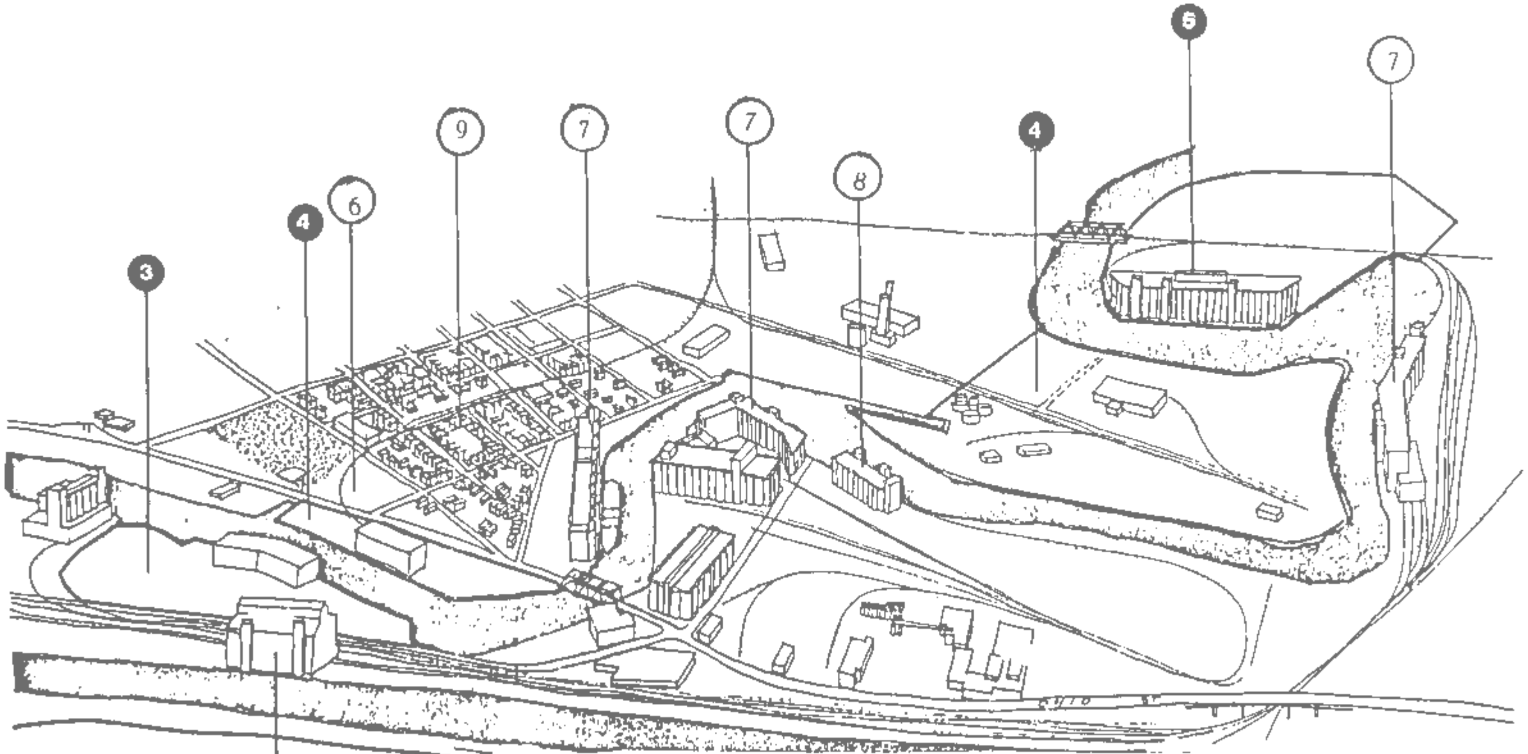
In the course of developing a Buffalo Waterfront Master Plan, the City's Department of Community Development, the State Department of Transportation, and their consultants compiled information on the current status of the waterfront into a section of the draft plan entitled "A Synthesis of Opportunities and Constraints". Figures 11.2 and 11.3 illustrate this information. Our review of this information leads us to the following overall conclusions about existing land use in the section of the waterfront within the Buffalo River basin:

- There is a large amount of vacant land in the area, with about one-fifth of the total acreage unused.

- The property near the river that is currently in use is used primarily for industrial, manufacturing, and transportation activities.

- At the present time there are, with the exception of a marina, a naval park and veterans' memorial near the mouth of the river, no public access, recreation, or natural habitat areas along the banks of the Buffalo River.

- Almost one-half of the vacant land in the area is privately-owned; about one-third is owned by the City of Buffalo, and the remainder is owned by other public entities.



WEST BUFFALO RIVER

<u>Vacant and Underutilized Land</u>

1. Underutilized rail lands potentially available for development.

2. Vacant industrial structure, Pillsbury grain elevators, valuable historic and aesthetic feature, the last of the "brick box type" elevators.

3. Underutilized industrial lands including vacant city-owned warehouse on the Buffalo River.

4. Underutilized industrial parcel on Ohio Street and the Buffalo River and on Katherine Street.

5. Vacant grain elevator, Concrete Central owned, by the City surrounded by 48 acres of vacant land owned by Owasco River Railway Corporation, presently inaccessible by road.

<u>Design and Access</u>

6. Ohio Street, proposed as part of the Riverwalk system, is at present a desolate streetscape that provides an opportunity for landscape improvements in coordination with improvements to Father Conway Park, and future development along the Buffalo River.

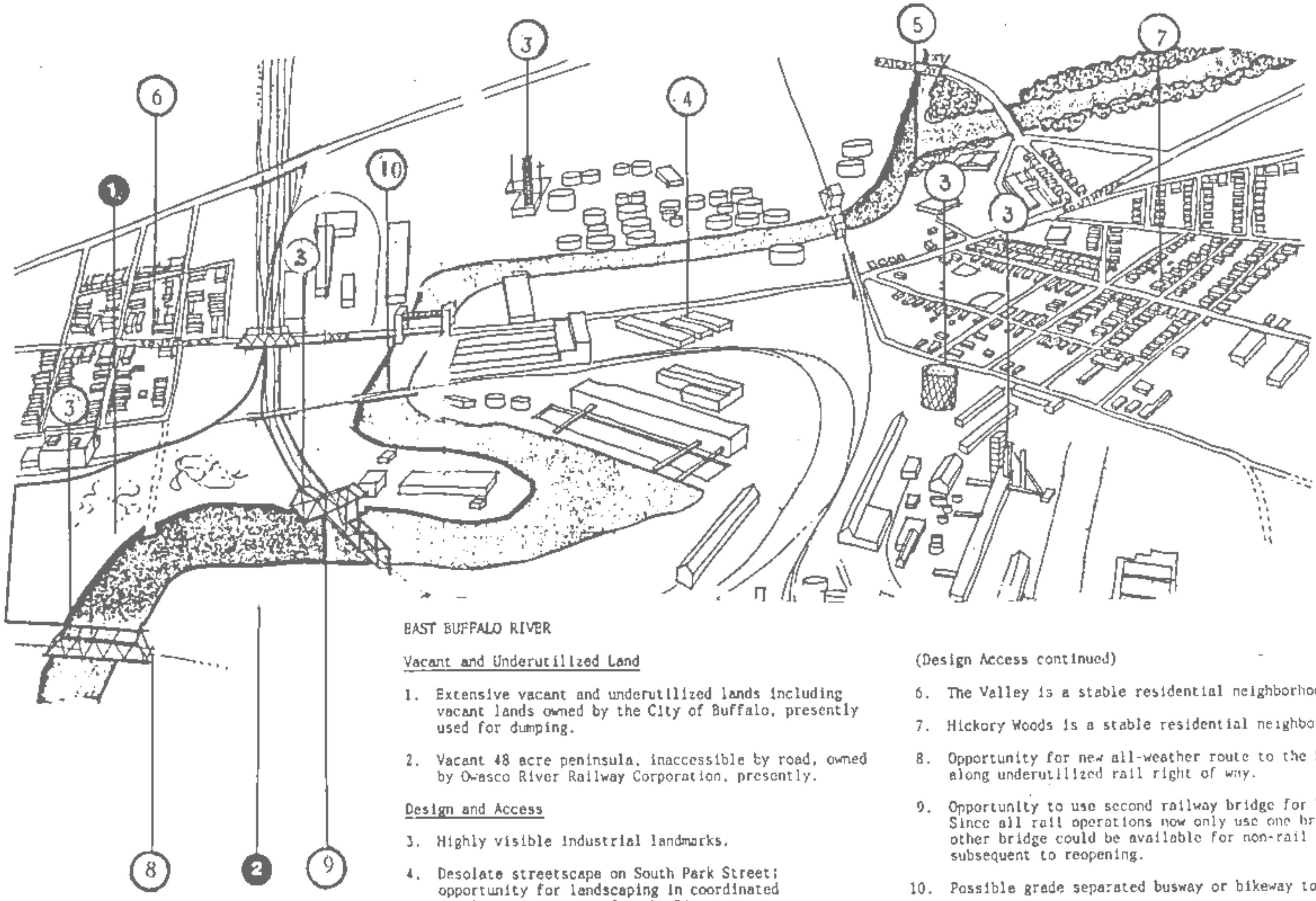
7. An awesome industrial ensemble: Cargill, American, Perot, Land and Rail, Standard and Cargill Superior, grain elevators: active industries.

8. Marine Terminal A grain elevator being adapted for reuse for aquaculture. If not developed within a specified time, will revert to City ownership.

9. Long established First Ward neighborhood is strong residential anchor.

Source: The Buffalo Waterfront Masterplan Draft 1987

Figure 11.2 - West Buffalo River from the Buffalo Waterfront Masterplan Draft Section "A Synthesis of Opportunities and Constraints"



EAST BUFFALO RIVER

Vacant and Underutilized Land

1. Extensive vacant and underutilized lands including vacant lands owned by the City of Buffalo, presently used for dumping.

2. Vacant 48 acre peninsula, inaccessible by road, owned by Owasco River Railway Corporation, presently.

Design and Access

3. Highly visible industrial landmarks.

4. Desolate streetscape on South Park Street; opportunity for landscaping in coordinated development strategy for the River.

5. Potential waterfront pathway connection to Olmsted's Cazenovia Park along Cazenovia Creek.

(Design Access continued)

6. The Valley is a stable residential neighborhood.

7. Hickory Woods is a stable residential neighborhood.

8. Opportunity for new all-weather route to the Southtowns along underutilized rail right of way.

9. Opportunity to use second railway bridge for bikeway. Since all rail operations now only use one bridge, the other bridge could be available for non-rail use subsequent to reopening.

10. Possible grade separated busway or bikeway to Downtown.

Source: The Buffalo Waterfront Masterplan Draft 1987

Figure 11.3 - East Buffalo River from the Buffalo Waterfront Masterplan Draft Section "A Synthesis of Opportunities and Constraints"

- More than one-half of the land in the area is not irreversibly committed to its current use and is, therefore, fairly susceptible to future changes in its use.

As pointed out above, the draft Buffalo Waterfront Master Plan indicates that more than one-half of the land area surveyed is not irreversibly committed to its present use. Figure 11.4 shows the degree to which various parcels of land are susceptible to change. Each parcel of land fits into one of three classifications, according to the degree to which it is committed to its current use: least committed to current use, moderately committed to current use, and most committed to current use.

Since about one-half of the land near the Buffalo River is fairly adaptable to future changes in the way it is used, there is a real opportunity to shape future land use and economic development efforts in the area to complement restoration of the Buffalo River ecosystem to beneficial uses. Indeed, the Buffalo River basin is ripe for new non-polluting land use and economic development activities which would improve the quality of life for people living in the area, while contributing to the restoration of the ecosystem upon which all living things - plants, and animals, and human beings - depend for survivial.

Land Use Plans as Community Visions

Since at least the early 1920's, a number of public and private plans, with varying degrees of official status, have been formulated to suggest appropriate general approaches for dealing with the problems and opportunities presented by the Buffalo waterfront, and the Buffalo River, which is at its core.

Figure 11.4 - Buffalo River Area land susceptible to change, from the Buffalo Waterfront Masterplan Draft

Such plans can be taken as general indicators of community sentiment concerning development and uses for the Buffalo River area. It is important to note, however, that there is no current plan accepted or approved by the community at large for waterfront or river development. There is reason to believe that the new Erie County Horizons Waterfront Commission will produce such a plan, and that this plan will reflect, in the light of present day realities, community and governmental attitudes toward the idealized future of waterfront development.

In the absence of an approved overall waterfront plan, the Buffalo River Citizens' Committee (BRCC) identified a few common threads connecting the variety of historic and proposed land use plans which have been reviewed. Taken together, all of the various plans represent a statement of the community's desire for environmental clean-up in the Buffalo River basin. Implementation of all of these proposals depend upon a clean-up of industrial pollution in the basin, and the restoration of the Buffalo River ecosystem to beneficial uses. All of the different plans also put forth the idea that the Buffalo waterfront is a key resource which needs to be better used, and that the problems and possibilities of this kind of resource require that special plans and efforts be made to use the resource as creatively and beneficially as possible.

The specific sub-themes within the general thrust toward better utilization of the waterfront have varied over time. For example, a 1922 plan called simply for industrial activity south of the mouth of the Buffalo River, with residential and commercial development north of the river's mouth, later plans called for mixed uses along both sides of the river.

The various sub-themes advanced within the general thrust toward better utilization have also depended upon the organizations or entities developing the various plans. Citizen groups interested in specific issue areas have produced limited plans supporting activity in their area of interest. Organizations advocating more parks and green spaces, such as Friends of Olmsted Parks, have advanced proposals for a greenbelt park system. The Industrial Heritage Committee's proposed Industrial Heritage Trail would highlight Buffalo's industrial and commercial history, and could connect with the greenbelt park system envisioned by Friends of Olmsted Parks. The Niagara Frontier Transportation Authority has produced a plan calling for a wider array of general uses in the Outer Harbor, while the City of Buffalo's draft Waterfront Master Plan recommendations call for a mix of uses for the Buffalo River area.

Three types of land use activities, however, predominate when we put all of the various plans and proposals together: recreational/park/public access development; residential development; and commercial/ industrial development. Beyond this, it is not possible to identify what is contemplated by the community for the Buffalo River as a whole, or for certain sites in the river area. The community, to the extent that it has spoken with one voice, seems to want the Buffalo River cleaned-up, restored, and available for various beneficial uses. Potential conflicts associated with the use of specific sites are as yet unresolved.

The creation of the Horizons Waterfront Commission is a major step forward toward well-planned and coordinated revitalization of Erie County's waterfront, including the Buffalo River area. The purpose of this commission will be to blend and refine the various ideas and proposals into an overall waterfront development plan and to bring about implementation of that plan. City, county, state, and federal agencies with responsibilities for managing Buffalo's waterfront will be able to shape this new coordinated planning process by channelling their input, plans, and visions through the Horizons Waterfront Commission. Table 11.1 shows the various agencies involved in the waterfront and the roles these agencies have traditionally played. Added to this listing are town governments, citizen and not-for-profit organizations, and private corporations. It is going to be a challenge for the Horizons Waterfront Commission to bring all of these varied groups together, in the common interest, to formulate an overall revitalization plan.

Recommendations on Future Land Use in the Buffalo River Area Of Concern

As the RAP restores the river's beneficial uses through environmental cleanup, the surrounding land area will benefit. Ultimately, the beneficial uses that are restored will depend not only upon cleanup and environmental management measures, but also upon the land use and revitalization plan(s) that are developed and carried out. As the RAP is implemented and pollution problems are remediated, many new land use opportunties will present themselves, along with the need to make critical decisions. This complex mix of opportunities, decisions (and potential pitfalls), combined with the various and sometimes competing interests involved in revitalization efforts, makes a coordinated land use planning process essential. The BRCC applauds the creation of the Horizons Waterfront Commission as an important first step in the direction of a coordinated waterfront plan for the Buffalo area.

TABLE 11.1

CITY, COUNTY, REGIONAL, STATE, AND FEDERAL AGENCIES WITH RESPONSIBILITIES FOR MANAGING BUFFALO'S WATERFRONT, FROM THE DRAFT BUFFALO WATERFRONT PLAN 1987

AGENCY		ROLE
Mayor's Office	City	Establishes overall development policy; coordinates state and federal legislative initiatives affecting city development policy to city agencies
Common Council	City	Adopts city budget and Capital Program determining public improvements to be made by the city and adopts development controls determining where various types of development will be permitted in the city, and establishing area, bulk and design controls
Department of Community Development	City	Responsible for initiation, implementation and administration of all community development projects and programs, and for coordinating development with existing plans, policies and funding sources; responsible for preparing and updating the Comprehensive Plan and the Community Development Program
Urban Renewal Agency	City	Designates areas as appropriate for urban renewal; is responsible for submitting urban renewal plans to the Buffalo Common Council; has, by statute, all the powers and duties of municipal renewal agencies including all those necessary to carry out and effectuate urban renewal projects
Enterprise Development Corporation	City	Undertake development; administer small business loans; oversees special projects including the Stadium and the Central District Heating project
Erie County Industrial Development Corporation	Erie County	Plans for Industrial development and implements programs designed to serve Industry in Buffalo and Erie County; Issues industrial revenue bonds
Erie-Niagara Counties Regional Planning Board	Region	Is responsible for developing a comprehensive planning process consistent with stated policy objectives in order to obtain federal planning assistance; reviews planning programs, projects and applications eligible to receive federal funding
Niagara Frontier Transportation Authority	Region	A public corporation intended to strengthen and improve transportation services for Western New York residents, and in particular for residents of Erie and Niagara Counties; major waterfront landowner (acres); has eminent domain powers
Niagara Frontier Transportation Committee	Region	Coordinates transportation processes in the Buffalo area; evaluates and approves transportation plan elements and facilitates administrative and legislative action on the local and state levels in implementing transportation plans; establishes advisory groups to represent interests concerned with transportation development in Erie and Niagara Counties
New York State Department of Transportation	State	Responsible for the state's highway and mass transit systems, aviation and marine transportation; serves as the state's comprehensive transportation planning agency
New York State Department of State	State	Administers Coastal Zone Management Program, designed to protect, preserve, develop and restore coastal land, water and air resources
New York State Department of Environmental Conservation	State	Administers the state's pollution control laws; plans, develops and manages programs relating to air, land and water pollution; administers flood plain management and flood control programs; controls dredging and filling navigable waters; construction of dams, freshwater wetlands; administers state Environmental Quality Review
New York State Urban Development Corporation	State	Helps the private sector plan, finance, construct and rehabilitate substandard or blighted areas
New York State Department of Health	State	Has the general responsibility for securing compliance with the Public Health Law and State Sanitary Code; determines water quality standards and establishes regulations for the sanitary control of water supplies; responsible for water quality surveillance; sanitary control of water supplies and pollution abatement control
Army Corps of Engineers	U.S.	Has primary responsibility for planning construction and operation of all major projects affecting U.S. waterways; issues permits for any construction on, over or above a navigable waterway or on adjoining wetland
Coast Guard	U.S.	In peacetime, operates as a service of the Department of Transportation; main functions include operation and maintenance of aids to navigation, icebreaking facilities, and rescue facilities on or under the high seas or other navigable waters
International Joint Commission	International	Investigates and makes recommendations regarding problems relating to the use of boundary waters between the U.S. and Canada; approves all proposals for use of boundary waters that would affect the natural flow or level of waters on either side of the international boundary
Buffalo River Improvement Corporation	NP	Corporate, city, state and federal group effort to clean up the Buffalo River by augmenting the water flow upstream
Tifft Farm Nature Preserve	NP	Responsible for maintaining the "mounds" area and the environmental safeguard installed at the site by the Buffalo Sewer Authority; provides environmental education services and acts as a passive recreation center

The recommendations discussed below will help provide ways for land use decision makers and developers to integrate the implementation of the RAP and other environmental concerns into their planning.

1. Plan for multiple land use along the Buffalo River. As previously noted, about one half of the land near the Buffalo River is fairly susceptible to positive future changes in the way it is used. A good portion of this land is vacant, with half the vacant land privately owned. As the RAP is implemented and the pollution problems threatening the river's ecosystem are addressed, the BRCC recommends that the Buffalo River area be put to multiple uses to benefit the community. These beneficial uses include:

- expanded green areas similar to the expanded park system advocated by the Friends of Olmsted Parks organization and the connecting trail proposed by the Industrial Heritage Committee

- public access and recreational areas

- shallow waters for fish habitats and fish propagation

- new non-polluting industries and commercial activity

2. Acquire and reserve land for public access, environmental conservation, and community enhancement. As the Horizons Waterfront Commission's planning process develops, the demand and market value of property may start to increase dramatically. Therefore, government agencies must begin to reserve land along the Buffalo River for environmentally sound and public benefit activities.

Among other activities, DEC should pursue the acquisition of areas for fish and wildlife habitat restoration and public access.

To provide public access to the river on privately owned land, the City of Buffalo should work to adopt legally sustainable setbacks of twenty feet for all private development along the river.

The BRCC recommends that the Horizons Waterfront Commission, and other jurisdictions responsible for developing the waterfront, research and develop innovative mechanisms to acquire unused, privately owned land for purposes that conform with the revitalization plan formulated by the Commission.

One example of an innovative mechanism to transfer private land to public land is the Land Trust Program of a bi-national organization called the Trust for Public Land (TPL). TPL conserves land as a living resource for present and future generations by working with government agencies and non-profit organizations to:

- acquire and preserve open space
- share knowledge of non-profit land acquisition processes
- pioneer methods of land conservation and environmentally sound land use.

Since 1973, TPL has protected 344,000 acres of scenic recreational, urban, rural, and wilderness land in 28 states and Canada. The types of land preserved by TPL range from the Massachusetts' Parker River National Wildlife Refuge to waterfront parks in Seattle, Washington and Cleveland, Ohio. TPL uses the substantial tax benefits available for donations of land to encourage private land owners to donate land to land trusts.

3. Insure a safe environment for new development. New development should not begin on property known to be or suspected of being contaminated with toxic chemicals until the area is either given a clean bill of health or is cleaned up under a state or federal remediation program.

4. Require Environmental Impact Studies to include Great Lakes Water Quality Agreement RAP criteria. Land use and economic development planning processes in the Buffalo River area of concern that require Environmental Impact Studies should consider the fourteen beneficial use impairments identified in the 1987 Great Lakes Water Quality Agreement to determine how the project affects the environment and the problems identified in the RAP. These fourteen use impairments as they currently apply to the Buffalo River are discussed in Chapter 4 of this RAP and summarized in Table 4.16. Any land use or development proposal which would contribute to one or more of the use impairments should either be adjusted to eliminate its detrimental impacts, or withdrawn from further consideration.

5. Prepare an Environmental Impact Study for the Waterfront Plan. The Horizons Waterfront Commission should, as required by law, prepare an Environmental Impact Study as part of their overall waterfront development plan, and ensure that the plan it creates for the waterfront does not contribute to any of the fourteen beneficial use impairments when it is carried out.

6. Prevent land use development from interfering with or delaying the RAP remediation process. The Horizons

Waterfront Commission, as well as other public agencies and private individuals and corporations involved in new land use projects must take steps to ensure that their plans do not interfere with either the implementation of the remedial recommendations outlined in Chapter 7 of the RAP or the specific investigation and remedial action programs at inactive hazardous waste sites.

Unless economic revitalization and land use activities in the Buffalo River area of concern are planned and conducted with regard for the RAP's program of environmental clean-up, the effectiveness of both efforts could be impaired.

7. Reduce hazardous material use and waste in the Buffalo River Area of Concern. Economic revitalization must be compatible with the RAP goals and the restoration of the Buffalo River ecosystem. The following recommendations regard the use of hazardous materials by industries in the area of concern:

- Managers of new and existing industries must work with DEC to reduce or eliminate the use of hazardous materials or the generation of hazardous waste. There is no universal toxic reduction blueprint that can be applied to all industries.

- DEC should fully implement the Waste Reduction Policy Statement issued by former Commissioner Henry Williams to DEC's Executive Staff, Division Directors, and Regional Directors on May 21,1987, as it applies to industries in the Buffalo River area of concern.

- A waste reduction goal of 10% each year should be set for existing industries on the Buffalo River.

- Inactive hazardous waste site remediation should be permanent so that the sites can someday be used for purposes other than the disposal of hazardous waste.

8. The Erie County Department of Environment & Planning, as well as municipal governments in the Buffalo River area, should promote the use of alternatives to pesticides currently used for commercial and residential application. This should be done through campaigns to educate the consumer and through the enactment of new legislation by Erie County. Although it is impossible to measure accurately how much pesticide and herbicide use contributes to toxic pollution of the Buffalo River, it is likely that pesticide-contaminated runoff does contribute to the problem. The overuse of pesticides and herbicides on residential lawns, and in parks, as well as by a broad range of business establishments, is one aspect of land use and economic activity which clearly must be changed. DEC should work with Erie County and municipal governments to implement a program to address this issue.

If revitalization of the Buffalo River is to become a reality, the RAP itself must be used by all as a truly effective tool in restoring the Buffalo River to a condition which will allow a range of beneficial land uses and economic development activities.

Specific Recommendations

The BRCC has developed the following specific land use recommendations for the Buffalo River area:

1. Develop an Environmental Discovery Center & Park. One of the most important specific BRCC land use recommendations is the proposal for an Environmental Discovery Center/Park

at 100 Bailey Avenue which is a major undertaking of the Friends of the Buffalo River, Incorporated. Located where Buffalo Creek and Cazenovia Creek join to form the Buffalo River, the site is ideal for this type of combined recreational/educational purpose. The proposed center would feature interactive displays and activities for children. These various displays and activities would focus on the Buffalo River, its history, the Remedial Action Plan, and the Great Lakes. Also included among them might be demonstrations on recycling and alternative non-polluting technologies. There would be easy access to the Center and the landscape surrounding it, both for cars and pedestrians. Recreational opportunities at the site would include boating, birdwatching, camping, urban gardening, fishing, and nature walks.

Buffalo Common Council member Brian Higgins, whose district includes the Buffalo River area, is playing a leading role in making this exciting proposal a reality. The Department of Architecture at the State University of New York at Buffalo is developing more detailed plans for the Center.

2. <u>The Horizons Waterfront Commission must, as one of its first tasks, develop a comprehensive citizen participation plan</u>. This is to involve the public in the waterfront planning process. This plan should include the publication of a regular newsletter, an open meetings policy for the Commission's regular meetings, and well-publicized community hearings in each sub-area of the waterfront before key policy decisions are made and aspects of the waterfront plan are implemented.

3. <u>DEC should pursue the purchase of 411 Ohio Street and work with local government to develop and maintain it for public access</u>. BRCC recommends continued cooperation

among local government and the community as DEC pursues the acquisition of 411 Ohio Street for public access to the Buffalo River and Lake Erie. While funding for the purchase will come from the New York State Environmental Quality Bond Act, development of the property, including a boat launch and parking facilities, will need additional state and local funding.

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TABLE A.1

CONTAMINANT CONCENTRATIONS IN BUFFALO RIVER WATER SAMPLES
OHIO STREET BRIDGE
APRIL 1982 - MARCH 1986

PARAMETER	UNITS	DETECT. LIMIT	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS	WATER QUALITY STANDARDS AND CRITERIA CLASS D	CLASS C/B	CLASS A
flow	cfs		30	328.4	186.5	98.0	344.0	0.0	713.0	2			
chloromethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
bromomethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
vinyl chloride	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.3 *
dichlorodifluoromethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
chloroethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
trichlorofluoromethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
dichloromethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
1,1-dichloroethene	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.07 *
1,1-dichloroethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
trans-1,2,dichloroethene	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
chloroform	ug/l	1	29	0.1	0.0	0.0	0.0	0.0	0.0	1	N.S.	N.S.	0.2
1,2-dichloroethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.8
1,1,1-trichloroethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
carbon tetrachloride	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.4 *
bromodichloromethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
1,2-dichloropropane	ug/l	1	29	0.0	0.0	0.0	0 0	0.0	0.0	0	N.S.	N.S.	50 * [1]
trans-1,3-dichloropropene	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
trichloroethene	ug/l	1	29	0.3	0.0	0.0	0.0	0.0	0.0	3	11 *	11 *	3 *
dibromochloromethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
cis-1,3-dichloropropene	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
1,1,2-trichloroethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.6
2-chloroethylvinyl ether	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
bromoform	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
1,1,2,2-tetrachloroethane	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.2 *
tetrachloroethene	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	1 *	1 *	0.7 *
chlorobenzene	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	50	5	5
1,3-dichlorobenzene	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	50 [1]	5 [1]	5 [1]
1,2-dichlorobenzene	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	50 [1]	5 [1]	5 [1]
1,4-dichlorobenzene	ug/l	1	29	0.0	0.0	0.0	0.0	0.0	0.0	0	50 [1]	5 [1]	5 [1]
benzene	ug/l	1	19	0.2	0.0	0.0	0.0	0.0	0.0	2	6 [1]	6 [1]	1.0 [1]
toluene	ug/l	1	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
ethylbenzene	ug/l	1	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
para xylene	ug/l	1	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 * [1]
meta xylene	ug/l	1	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 * [1]
ortho xylene	ug/l	1	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 * [1]
phenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	5	5	1.0
2-chlorophenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.

TABLE A.1 (continued)

PARAMETER	UNITS	DETECT. LIMIT	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS	WATER QUALITY STANDARDS AND CRITERIA CLASS D	CLASS C/B	CLASS A
2-nitrophenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
2,4-dimethylphenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
2,4-dichlorophenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
4-chloro-3-methylphenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
2,4,6-trichlorophenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
2,4,5-trichlorophenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
2,4-dinitrophenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
4-nitrophenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
2-methyl-4,6-dinitrophenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
pentachlorophenol	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	1	0.4	0.4
benzoic acid	ug/l	10	4	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
bis(2-chloroisopropyl)ether	ug/l	10	6	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
bis(2-chloroethyl)ether	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.03 *
N-nitrosodimethylamine	ug/l	10	16	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
N-nitrosodi-n-propylamine	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
hexachloroethane	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
nitrobenzene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	30
isophorone	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
bis(2-chloroethoxy)methane	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
1,2,4-trichlorobenzene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	50 [1]	5 [1]	5 [1]
naphthalene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	10
hexachlorobutadiene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	10	1	0.5
hexachlorocyclopentadiene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	4.5	0.45	0.45
2-chloronaphthalene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	10
2,6-dinitrotoluene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.07 *
acenaphthylene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
dimethylphthalate	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
acenaphthene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	20
2,4-dinitrotoluene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
diethylphthalate	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
fluorene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
4-chlorophenylphenylether	ug/l	10	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
N-nitrosodiphenylamine	ug/l	10	14	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
1,2-diphenylhydrazine	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.05 *
4-bromophenylphenylether	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
hexachlorobenzene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.02 *
phenanthrene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
anthracene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
di-n-butylphthalate	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
fluoranthane	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
pyrene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
benzidine	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.1	0.1	0.1
butylbenzylphthalate	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 *
benzo(a)anthracene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.002 *
3,3'-dichlorobenzidine	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.

TABLE A.1 (continued)

PARAMETER	UNITS	DETECT. LIMIT	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS	WATER QUALITY STANDARDS AND CRITERIA CLASS D	CLASS C/B	CLASS A
bis(2-ethylhexyl)phthalate	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	0.6	0.6
chrysene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.002 *
dioctylphthalate	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
benzo(b)fluoranthene	ug/l	30	10	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.002 *
benzo(k)fluoranthene	ug/l	30	10	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.002 *
benzo(a)pyrene	ug/l	30	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0012 *	0.0012 *	0.0012 *
indeno(1,2,3-cd)pyrene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	0.002 *
dibenzo(a,h)anthracene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
benzo(g,h,i)perylene	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
alpha-BHC	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	2 [1]	0.01 [1]	0.01 [1]
beta-BHC	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	2 [1]	0.01 [1]	0.01 [1]
gamma-BHC	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	2 [1]	0.01 [1]	0.01 [1]
delta-BHC	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	2 [1]	0.01 [1]	0.01 [1]
heptachlor	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.001	0.001	0.001
aldrin	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.001	0.001	0.001 [6]
heptachlor epoxide	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.001	0.001	0.001
endosulfan I	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.22	0.009	0.009
4,4'-DDE	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.001	0.001	0.001
dieldrin	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.001	0.001	0.001 [6]
endrin	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.002	0.002	0.002
4,4'-DDD	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.001	0.001	0.001
endosulfan II	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.22	0.009	0.009
endrin aldehyde	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
endosulfan sulfate	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
4,4'-DDT	ug/l	10	19	0.0	0.0	0.0	0.0	0.0	0.0	0	0.001	0.001	0.001
zinc	ug/l	20 [15]	30	12.3	0.0	0.0	30.0	0.0	75.0	0	435 [2,5]	30 [2]	30 [2]
lead	ug/l	10	30	9.1	0.0	0.0	0.0	0.0	0.0	2	131 [2,5]	5 [2,5]	5 [2,5]
beryllium	ug/l	2 [16]	30	0.0	0.0	0.0	0.0	0.0	0.0	1	N.S.	1100 [5]	1100 [5]
copper	ug/l	10 [17]	30	0.0	0.0	0.0	0.0	0.0	0.0	0	25 [2,5]	16 [2,5]	16 [2,5]
nickel	ug/l	1 [18]	30	1.2	0.0	0.0	1.6	0.0	4.0	4	2433 [2,5]	126 [2,5]	126 [2,5]
silver	ug/l	1 [19]	30	0.0	0.0	0.0	0.0	0.0	0.0	0	8 [3,5]	0.1 [3]	0.1 [3]
mercury	ug/l	0.2 [20]	30	0.0	0.0	0.0	0.0	0.0	0.0	2	0.2 *	0.2 *	0.2 * [7]
arsenic	ug/l	10	30	0.0	0.0	0.0	0.0	0.0	0.0	0	360 [4]	190 [4]	50
cadmium	ug/l	1 [21]	30	0.1	0.0	0.0	0.0	0.0	0.0	2	6 [2,5]	2 [2,5]	2 [2,5]
antimony	ug/l	5 [22]	30	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	3 *
thallium	ug/l	10 [23]	30	0.0	0.0	0.0	0.0	0.0	0.0	0	20 [2]	8 [2]	8 [2]
chromium	ug/l	10	30	1.0	0.0	0.0	0.0	0.0	0.0	2	2341 [2,5]	12 [2,5]	12 [2,5]
selenium	ug/l	5 [24]	30	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	1 [2]	1.0 [2]
1-chlorocyclohexene-1	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
cumene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
styrene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
p-bromofluorobenzene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
n-propylbenzene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
tert-butylbenzene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
o/p-chlorotoluene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.

TABLE A.1 (continued)

PARAMETER	UNITS	DETECT. LIMIT	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS	WATER QUALITY STANDARDS AND CRITERIA CLASS D	CLASS C/B	CLASS A
bromobenzene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
metachlorotoluene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
1,3,5-trimethylbenzene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 [1]
1,2,4-trimethylbenzene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	50 [1]
p-cymene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
cyclopropylbenzene	ug/l	1	14	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
sec-butylbenzene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
n-butylbenzene	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
2,3-benzofuran	ug/l	1	8	0.0	0.0	0.0	0.0	0.0	0.0	0	N.S.	N.S.	N.S.
1,2,3-trichlorobenzene	ug/l	5	8	0.0	0.0	0.0	0.0	0.0	0.0	0	50 [1]	5 [1]	5 [1]
ammonia	mg/l		18	0.3	0.2	0.1	0.3	0.0	0.6	0	6.8 [8]	1.8 [8]	1.8 [8]
nitrogen (NO2)	ug/l		18	27.6	33.0	15.0	38.0	0.0	72.5	0	N.S.	100	100
nitrogen (NO2,NO3)	mg/l		18	0.3	0.3	0.2	0.5	0.0	0.9	0	N.S.	N.S.	N.S.
phenols (4AAP)	ug/l	1	24	1.2	1.0	0.0	2.0	0.0	5.0	0	5 [9]	5 [9]	1.0
pH	SU		24	7.7	7.6	7.5	7.8	7.0	8.2	3	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
TSS	mg/l		18	18.0	13.0	11.0	22.0	0.0	38.5	1	N.S.	N.S.	N.S.
BOD7	mg/l		23	2.8	2.6	2.0	3.2	0.2	5.0	0	N.S.	N.S.	N.S.
coliform, total	/100ml		23	10428.7	5000.0	2050.0	15500.0	0.0	35675.0	2	N.S. [10]	N.S. [10]	5000 [11]
coliform, fecal	/100ml		23	562.3	140.0	70.0	485.0	0.0	1107.5	4	N.S. [12]	N.S. [12]	200 [13]
turbidity			18	12.4	6.8	4.8	17.0	0.0	35.3	2	N.S.	N.S.	N.S.
alkalinity	mg/l		24	104.8	106.5	98.5	111.5	79.0	131.0	1	N.S.	N.S.	N.S.
temperature	deg C		24	18.1	18.5	15.5	23.0	4.2	34.2	0	32	32	32
conductivity			18	354.4	357.5	325.0	385.0	235.0	475.0	1	N.S.	N.S.	N.S.
dissolved oxygen	mg/l		23	6.9	6.5	5.1	8.6	0.0	13.7	0	3	4 [14]	4 [14]
TKN	mg/l		12	0.5	0.5	0.1	0.9	0.0	1.9	0	N.S.	N.S.	N.S.
phosphate, total	mg/l		16	0.1	0.1	0.0	0.1	0.0	0.1	1	N.S.	N.S.	N.S.
COD	mg/l		18	20.9	20.0	16.0	24.0	4.0	36.0	1	N.S.	N.S.	N.S.
hardness	mg/l		5	144.0	150.0	120.0	160.0	60.0	220.0	0	N.S.	N.S.	N.S.

WATER QUALITY STANDARD AND GUIDANCE VALUE FOOTNOTES

N.S. - No standard or guidance value
* - Guidance value
[1] - Applies to sum of isomers
[2] - Applies to acid soluable form
[3] - Applies to ionic form
[4] - Applies to dissolved form
[5] - Calculated based on 144 mg/l hardness
[6] - Applies to sum of aldrin and dieldrin
[7] - Standard not greater than 2 ug/l
[8] - Calculated based on pH = 7.67 and temperature = 18.125 C
[9] - Total unchlorinated
[10] - Monthly median not greater than 2400/100ml from a minimum of five examinations when disinfection is practiced.
[11] - Monthly median not greater than 5000/100ml from a minimum of five examinations.
[12] - Monthly geometric mean not greater than 200/100ml from a minimum of five examinations when disinfection is practiced.
[13] - Monthly geometric mean not greater than 200/100ml from a minimum of five examinations.
[14] - Minimum daily average not less than 5 mg/l

Non-detect values are presented as zero for statistical evaluations.

TABLE A.2

NEW YORK STATE
WATER QUALITY STANDARDS AND CRITERIA EXCEEDANCES
OF BUFFALO RIVER WATER SAMPLES
OHIO STREET BRIDGE
APRIL 1982 - MARCH 1986

PARAMETER	UNITS	DETECT. LIMIT	NO. OF SAMPLES	CLASS D	EXCEED-ANCES	CLASS C/B	EXCEED-ANCES	CLASS A	EXCEED-ANCES
chloromethane	ug/l	1	29	N.S.		N.S.		N.S.	
bromomethane	ug/l	1	29	N.S.		N.S.		N.S.	
vinyl chloride	ug/l	1	29	N.S.		N.S.		0.3 *	+ 0
dichlorodifluoromethane	ug/l	1	29	N.S.		N.S.		N.S.	
chloroethane	ug/l	1	29	N.S.		N.S.		N.S.	
trichlorofluoromethane	ug/l	1	29	N.S.		N.S.		50 *	0
dichloromethane	ug/l	1	29	N.S.		N.S.		N.S.	
1,1-dichloroethene	ug/l	1	29	N.S.		N.S.		0.07 *	+ 0
1,1-dichloroethane	ug/l	1	29	N.S.		N.S.		50 *	0
trans-1,2,dichloroethene	ug/l	1	29	N.S.		N.S.		50 *	0
chloroform	ug/l	1	29	N.S.		N.S.		0.2	+ 1
1,2-dichloroethane	ug/l	1	29	N.S.		N.S.		0.8	+ 0
1,1,1-trichloroethane	ug/l	1	29	N.S.		N.S.		50 *	0
carbon tetrachloride	ug/l	1	29	N.S.		N.S.		0.4 *	+ 0
bromodichloromethane	ug/l	1	29	N.S.		N.S.		50 *	0
1,2-dichloropropane	ug/l	1	29	N.S.		N.S.		50 * [1]	0
trans-1,3-dichloropropene	ug/l	1	29	N.S.		N.S.		N.S.	
trichloroethene	ug/l	1	29	11 *	0	11 *	0	3 *	1
dibromochloromethane	ug/l	1	29	N.S.		N.S.		50 *	0
cis-1,3-dichloropropene	ug/l	1	29	N.S.		N.S.		N.S.	
1,1,2-trichloroethane	ug/l	1	29	N.S.		N.S.		0.6	+ 0
2-chloroethylvinyl ether	ug/l	1	29	N.S.		N.S.		N.S.	
bromoform	ug/l	1	29	N.S.		N.S.		50 *	0
1,1,2,2-tetrachloroethane	ug/l	1	29	N.S.		N.S.		0.2 *	+ 0
tetrachloroethene	ug/l	1	29	1 *	0	1 *	0	0.7 *	+ 0
chlorobenzene	ug/l	1	29	50	0	5	0	5	0
1,3-dichlorobenzene	ug/l	1	29	50 [1]	0	5 [1]	0	5 [1]	0
1,2-dichlorobenzene	ug/l	1	29	50 [1]	0	5 [1]	0	5 [1]	0
1,4-dichlorobenzene	ug/l	1	29	50 [1]	0	5 [1]	0	5 [1]	0
benzene	ug/l	1	19	6 *	0	6 *	0	1.0 *	1
toluene	ug/l	1	19	N.S.		N.S.		50 *	0
ethylbenzene	ug/l	1	19	N.S.		N.S.		50 *	0
para xylene	ug/l	1	19	N.S.		N.S.		50 * [1]	0
meta xylene	ug/l	1	19	N.S.		N.S.		50 * [1]	0
ortho xylene	ug/l	1	19	N.S.		N.S.		50 * [1]	0
phenol	ug/l	10	19	5	+ 0	5	+ 0	1.0	+ 0
2-chlorophenol	ug/l	10	19	N.S.		N.S.		N.S.	

TABLE A.2 (continued)

PARAMETER	UNITS	DETECT. LIMIT	NO. OF SAMPLES	CLASS D	EXCEED-ANCES	CLASS C/B	EXCEED-ANCES	CLASS A	EXCEED-ANCES
2-nitrophenol	ug/l	10	19	N.S.		N.S.		N.S.	
2,4-dimethylphenol	ug/l	10	19	N.S.		N.S.		N.S.	
2,4-dichlorophenol	ug/l	10	19	N.S.		N.S.		N.S.	
4-chloro-3-methylphenol	ug/l	10	19	N.S.		N.S.		N.S.	
2,4,6-trichlorophenol	ug/l	10	19	N.S.		N.S.		N.S.	
2,4,5-trichlorophenol	ug/l	10	19	N.S.		N.S.		N.S.	
2,4-dinitrophenol	ug/l	10	19	N.S.		N.S.		N.S.	
4-nitrophenol	ug/l	10	19	N.S.		N.S.		N.S.	
2-methyl-4,6-dinitrophenol	ug/l	10	19	N.S.		N.S.		N.S.	
pentachlorophenol	ug/l	10	19	1	+ 0	0.4	+ 0	0.4	+ 0
benzoic acid	ug/l	10	4	N.S.		N.S.		N.S.	
bis(2-chloroisopropyl)ether	ug/l	10	6	N.S.		N.S.		N.S.	
bis(2-chloroethyl)ether	ug/l	10	19	N.S.		N.S.		0.03 *	+ 0
N-nitrosodimethylamine	ug/l	10	16	N.S.		N.S.		N.S.	
N-nitrosodi-n-propylamine	ug/l	10	19	N.S.		N.S.		N.S.	
hexachloroethane	ug/l	10	19	N.S.		N.S.		N.S.	
nitrobenzene	ug/l	10	19	N.S.		N.S.		30	0
isophorone	ug/l	10	19	N.S.		N.S.		50 *	0
bis(2-chloroethoxy)methane	ug/l	10	19	N.S.		N.S.		N.S.	
1,2,4-trichlorobenzene	ug/l	10	19	50 [1]	0	5 [1]	+ 0	5 [1]	+ 0
naphthalene	ug/l	30	19	N.S.		N.S.		10	+ 0
hexachlorobutadiene	ug/l	10	19	10	0	1	+ 0	0.5	+ 0
hexachlorocyclopentadiene	ug/l	10	19	4.5	+ 0	0.45	+ 0	0.45	+ 0
2-chloronaphthalene	ug/l	10	19	N.S.		N.S.		10	0
2,6-dinitrotoluene	ug/l	10	19	N.S.		N.S.		0.07 *	+ 0
acenaphthylene	ug/l	30	19	N.S.		N.S.		N.S.	
dimethylphthalate	ug/l	10	19	N.S.		N.S.		50 *	0
acenaphthene	ug/l	30	19	N.S.		N.S.		20	+ 0
2,4-dinitrotoluene	ug/l	10	19	N.S.		N.S.		N.S.	
diethylphthalate	ug/l	10	19	N.S.		N.S.		50 *	0
fluorene	ug/l	30	19	N.S.		N.S.		50 *	0
4-chlorophenylphenylether	ug/l	10	8	N.S.		N.S.		N.S.	
N-nitrosodiphenylamine	ug/l	10	14	N.S.		N.S.		50 *	0
1,2-diphenylhydrazine	ug/l	10	19	N.S.		N.S.		0.05 *	+ 0
4-bromophenylphenylether	ug/l	10	19	N.S.		N.S.		N.S.	
hexachlorobenzene	ug/l	10	19	N.S.		N.S.		0.02 *	+ 0
phenanthrene	ug/l	30	19	N.S.		N.S.		50 *	0
anthracene	ug/l	30	19	N.S.		N.S.		50 *	0
di-n-butylphthalate	ug/l	10	19	N.S.		N.S.		50 *	0
fluoranthane	ug/l	30	19	N.S.		N.S.		50 *	0
pyrene	ug/l	30	19	N.S.		N.S.		50 *	0
benzidine	ug/l	10	19	0.1	+ 0	0.1	+ 0	0.1	+ 0
butylbenzylphthalate	ug/l	10	19	N.S.		N.S.		50 *	0
benzo(a)anthracene	ug/l	30	19	N.S.		N.S.		0.002 *	+ 0
3,3'-dichlorobenzidine	ug/l	10	19	N.S.		N.S.		N.S.	

TABLE A.2 (continued)

PARAMETER	UNITS	DETECT. LIMIT	NO. OF SAMPLES	CLASS D	EXCEED-ANCES	CLASS C/B	EXCEED-ANCES	CLASS A	EXCEED-ANCES
bis(2-ethylhexyl)phthalate	ug/l	10	19	N.S.		0.6	+ 0	0.6	+ 0
chrysene	ug/l	30	19	N.S.		N.S.		0.002 *	+ 0
dioctylphthalate	ug/l	10	19	N.S.		N.S.		N.S.	
benzo(b)fluoranthene	ug/l	30	10	N.S.		N.S.		0.002 *	+ 0
benzo(k)fluoranthene	ug/l	30	10	N.S.		N.S.		0.002 *	+ 0
benzo(a)pyrene	ug/l	30	19	0.0012 *	+ 0	0.0012 *	+ 0	0.0012 *	+ 0
indeno(1,2,3-cd)pyrene	ug/l	10	19	N.S.		N.S.		0.002 *	+ 0
dibenzo(a,h)anthracene	ug/l	10	19	N.S.		N.S.		N.S.	
benzo(g,h,i)perylene	ug/l	10	19	N.S.		N.S.		N.S.	
alpha-BHC	ug/l	10	19	2 [1]	+ 0	0.01 [1]	+ 0	0.01 [1]	+ 0
beta-BHC	ug/l	10	19	2 [1]	+ 0	0.01 [1]	+ 0	0.01 [1]	+ 0
gamma-BHC	ug/l	10	19	2 [1]	+ 0	0.01 [1]	+ 0	0.01 [1]	+ 0
delta-BHC	ug/l	10	19	2 [1]	+ 0	0.01 [1]	+ 0	0.01 [1]	+ 0
heptachlor	ug/l	10	19	0.001	+ 0	0.001	+ 0	0.001	+ 0
aldrin	ug/l	10	19	0.001	+ 0	0.001	+ 0	0.001 [6]	+ 0
heptachlor epoxide	ug/l	10	19	0.001	+ 0	0.001	+ 0	0.001	+ 0
endosulfan I	ug/l	10	19	0.22	+ 0	0.009	+ 0	0.009	+ 0
4,4'-DDE	ug/l	10	19	0.001	+ 0	0.001	+ 0	0.001	+ 0
dieldrin	ug/l	10	19	0.001	+ 0	0.001	+ 0	0.001 [6]	+ 0
endrin	ug/l	10	19	0.002	+ 0	0.002	+ 0	0.002	+ 0
4,4'-DDD	ug/l	10	19	0.001	+ 0	0.001	+ 0	0.001	+ 0
endosulfan II	ug/l	10	19	0.22	+ 0	0.009	+ 0	0.009	+ 0
endrin aldehyde	ug/l	10	19	N.S.		N.S.		N.S.	
endosulfan sulfate	ug/l	10	19	N.S.		N.S.		N.S.	
4,4'-DDT	ug/l	10	19	0.001	+ 0	0.001	+ 0	0.001	0
zinc	ug/l	20 [15]	30	435 [2,5]	0	30 [2]	5	30 [2]	5
lead	ug/l	10	30	131 [2,5]	1	5 [2,5]	+ 2	5 [2,5]	+ 2
beryllium	ug/l	2 [16]	30	N.S.		1100 [5]	0	1100 [5]	0
copper	ug/l	10 [17]	30	25 [2,5]	0	16 [2,5]	0	16 [2,5]	0
nickel	ug/l	1 [18]	30	2433 [2,5]	0	126 [2,5]	0	126 [2,5]	0
silver	ug/l	1 [19]	30	8 [3,5]	0	0.1 [3]	+ 0	0.1 [3]	+ 0
mercury	ug/l	0.2 [20]	30	0.2 *	1	0.2 *	1	0.2 * [7]	1
arsenic	ug/l	10	30	360 [4]	0	190 [4]	0	50	0
cadmium	ug/l	1 [21]	30	6 [2,5]	0	2 [2,5]	0	2 [2,5]	0
antimony	ug/l	5 [22]	30	N.S.		N.S.		3 *	+ 0
thallium	ug/l	10 [23]	30	20 [2]	0	8 [2]	+ 0	8 [2]	+ 0
chromium	ug/l	10	30	2341 [2,5]	0	12 [2,5]	2	12 [2,5]	2
selenium	ug/l	5 [24]	30	N.S.		1 [2]	+ 0	1.0 [2]	+ 0
1-chlorocyclohexene-1	ug/l	1	8	N.S.		N.S.		N.S.	
cumene	ug/l	1	8	N.S.		N.S.		N.S.	
styrene	ug/l	1	8	N.S.		N.S.		N.S.	
p-bromofluorobenzene	ug/l	1	8	N.S.		N.S.		N.S.	
n-propylbenzene	ug/l	1	8	N.S.		N.S.		N.S.	
tert-butylbenzene	ug/l	1	8	N.S.		N.S.		N.S.	
o/p-chlorotoluene	ug/l	1	8	N.S.		N.S.		N.S.	

TABLE A.2 (continued)

PARAMETER	UNITS	DETECT. LIMIT	NO. OF SAMPLES	CLASS D	EXCEED-ANCES	CLASS C/B	EXCEED-ANCES	CLASS A	EXCEED-ANCES
bromobenzene	ug/l	1	8	N.S.		N.S.		N.S.	
metachlorotoluene	ug/l	1	8	N.S.		N.S.		N.S.	
1,3,5-trimethylbenzene	ug/l	1	8	N.S.		N.S.		50 [1]	0
1,2,4-trimethylbenzene	ug/l	1	8	N.S.		N.S.		50 [1]	0
p-cymene	ug/l	1	8	N.S.		N.S.		N.S.	
cyclopropylbenzene	ug/l	1	14	N.S.		N.S.		N.S.	
sec-butylbenzene	ug/l	1	8	N.S.		N.S.		N.S.	
n-butylbenzene	ug/l	1	8	N.S.		N.S.		N.S.	
2,3-benzofuran	ug/l	1	8	N.S.		N.S.		N.S.	
1,2,3-trichlorobenzene	ug/l	5	8	50 [1]	0	5 [1]	0	5 [1]	0
ammonia	mg/l		18	6.8 [8]	0	1.8 [8]	0	1.8 [8]	0
nitrogen (NO2)	ug/l		18	N.S.		100	0	100	0
nitrogen (NO2,NO3)	mg/l		18	N.S.		N.S.		N.S.	
phenols (4AAP)	ug/l	1	24	5 [9]	0	5 [9]	0	1.0	11
pH	SU		24	6.5 - 8.5	1	6.5 - 8.5	1	6.5 - 8.5	1
TSS	mg/l		18	N.S.		N.S.		N.S.	
BOD7	mg/l		23	N.S.		N.S.		N.S.	
coliform, total	/100ml		23	N.S. [10]		N.S. [10]		5000 [11]	10
coliform, fecal	/100ml		23	N.S. [12]		N.S. [12]		200 [13]	10
turbidity			18	N.S.		N.S.		N.S.	
alkalinity	mg/l		24	N.S.		N.S.		N.S.	
temperature	deg C		24	32	0	32	0	32	0
conductivity			18	N.S.		N.S.		N.S.	
dissolved oxygen	mg/l		23	3	0	4 [14]	4	4 [14]	4
TKN	mg/l		12	N.S.		N.S.		N.S.	
phosphate, total	mg/l		16	N.S.		N.S.		N.S.	
COD	mg/l		18	N.S.		N.S.		N.S.	
hardness	mg/l		5	N.S.		N.S.		N.S.	

WATER QUALITY STANDARD AND GUIDANCE VALUE FOOTNOTES

Class A - Best usage drinking water supply
Class B - Best usage primary contact recreation
Class C - Best usage fishing and fish propagation
Class D - Best usage fishing
N.S. - No standard or guidance value
* - Guidance value
\+ - Detection limit greater than standard or guidance value
[1] - Applies to sum of isomers
[2] - Applies to acid soluable form
[3] - Applies to ionic form
[4] - Applies to dissolved form
[5] - Calculated based on 144 mg/l hardness
[6] - Applies to sum of aldrin and dieldrin
[7] - Standard not greater than 2 ug/l
[8] - Calculated based on pH = 7.67 and temperature = 18.125 C
[9] - Total unchlorinated
[10] - Monthly median not greater than 2400/100ml from a minimum of five examinations when disinfection is practiced.
[11] - Monthly median not greater than 5000/100ml from a minimum of five examinations.
[12] - Monthly geometric mean not greater than 200/100ml from a minimum of five examinations when disinfection is practiced.
[13] - Monthly geometric mean not greater than 200/100ml from a minimum of five examinations.
[14] - Minimum daily average not less than 5 mg/l
[15] - Detection limit was 50 ug/l in 1982-85
[16] - Detection limit was 20 ug/l in 1982-84
[17] - Detection limit was 50 ug/l in 1982-84
[18] - Detection limit was 50 ug/l in 1982-84
[19] - Detection limit was 20 ug/l in 1982-84
[20] - Detection limit was 0.4 ug/l in 1982-83
[21] - Detection limit was 2 ug/l in 1982-84
[22] - Detection limit was 1000 ug/l in 1982-84
[23] - Detection limit was 1000 ug/l in 1982-84
[24] - Detection limit was 10 ug/l in 1982-83

TABLE A.3

CONTAMINANT CONCENTRATIONS IN BUFFALO RIVER BOTTOM SEDIMENTS
FOR PARAMETERS QUANTIFIED
USEPA - REGION V SAMPLING - 1981
(ug/g)

PARAMETER	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
1,1,1-trichloroethane	17	0.001	0.000	0.000	0.000	0.000	0.000	1
1,1,2,2-tetrachloroethane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
1,1,2-trichloroethane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
1,1,3-trimethylcyclohexane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
1,1-dichloroethane	17	0.001	0.000	0.000	0.000	0.000	0.000	2
1,1-dichloroethene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
1,2-dichloroethane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
1,2-dichloroethylene	17	0.002	0.000	0.000	0.000	0.000	0.000	1
1,2-dichloropropane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
1-methyl-2-propylcyclopentane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
2-butanone	17	0.000	0.000	0.000	0.000	0.000	0.000	0
2-chloroethylvinyl ether	17	0.000	0.000	0.000	0.000	0.000	0.000	0
2-hexanone	17	0.000	0.000	0.000	0.000	0.000	0.000	0
2-methylhexane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
2-(2-propenyl)toluene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
3-methylhexane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
4-methyl-2-pentanone	17	0.000	0.000	0.000	0.000	0.000	0.000	0
acetone	17	0.000	0.000	0.000	0.000	0.000	0.000	0
benzene	17	0.122	0.000	0.000	0.000	0.000	0.000	4
bromodichloromethane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
bromoform	17	0.000	0.000	0.000	0.000	0.000	0.000	0
bromomethane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
carbon disulfide	17	0.000	0.000	0.000	0.000	0.000	0.000	0
carbon tetrachloride	17	0.000	0.000	0.000	0.000	0.000	0.000	0
chlorobenzene	17	2.349	0.000	0.000	0.016	0.000	0.040	4
chloroethane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
chloroform	17	0.047	0.000	0.000	0.032	0.000	0.080	1
chloromethane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
chlorotoluene	17	0.265	0.000	0.000	0.000	0.000	0.000	1
cis-1,3-dichloropropene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
cyclohexane	17	0.100	0.000	0.000	0.000	0.000	0.000	1
dibromochloromethane	17	0.002	0.000	0.000	0.000	0.000	0.000	3
dibromoethane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
dichlorobenzene	17	0.100	0.000	0.000	0.000	0.000	0.000	1
diethyl ether	17	0.040	0.000	0.000	0.000	0.000	0.000	2
dimethylcyclohexane	17	0.008	0.000	0.000	0.000	0.000	0.000	1
dimethylcyclopentane	17	0.002	0.000	0.000	0.000	0.000	0.000	1
ethylbenzene	17	0.056	0.000	0.000	0.000	0.000	0.000	4

TABLE A.3 (continued)

PARAMETER	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
ethylcyclopentane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
ethyltoluene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
hydrocarbons-volatile	17	0.000	0.000	0.000	0.000	0.000	0.000	0
methylcyclodecane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
methylcyclohexane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
methylene chloride	17	0.232	0.020	0.000	0.035	0.000	0.088	3
N-nitrosodimethylamine	17	0.000	0.000	0.000	0.000	0.000	0.000	0
propylbenzene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
styrene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
tetrachloroethene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
tetrachloroethylene	17	0.114	0.000	0.000	0.000	0.000	0.000	2
toluene	17	0.691	0.000	0.000	0.040	0.000	0.100	2
trans-1,2-dichloroethene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
trans-1,3-dichloropropene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
tribromomethane	17	0.001	0.000	0.000	0.000	0.000	0.000	3
trichloroethane	17	0.000	0.000	0.000	0.000	0.000	0.000	1
trichloroethene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
trichloroethylene	17	0.002	0.000	0.000	0.000	0.000	0.000	1
trimethylbenzene	17	0.000	0.000	0.000	0.000	0.000	0.000	0
trimethylcyclohexane	17	0.000	0.000	0.000	0.000	0.000	0.000	0
vinyl acetate	17	0.000	0.000	0.000	0.000	0.000	0.000	0
vinyl chloride	17	0.000	0.000	0.000	0.000	0.000	0.000	0
(hydrocarbons-alcohols)	17	0.000	0.000	0.000	0.000	0.000	0.000	0
(substituded cyclohexanes)	17	0.000	0.000	0.000	0.000	0.000	0.000	0
m-xylene	17	0.126	0.000	0.000	0.020	0.000	0.050	4
o-xylene	17	0.097	0.000	0.000	0.020	0.000	0.050	3
p-xylene	17	0.097	0.000	0.000	0.020	0.000	0.050	3
1,2,4-trichlorobenzene	16	11.794	0.000	0.000	0.000	0.000	0.000	3
1,2-dichlorobenzene	16	11.775	0.000	0.000	1.850	0.000	4.625	3
1,3-dichlorobenzene	16	0.356	0.000	0.000	0.150	0.000	0.375	3
1,4-dichlorobenzene	16	0.431	0.000	0.000	0.550	0.000	1.375	2
1,3&4-dichlorobenzene	16	1.112	0.000	0.000	0.000	0.000	0.000	2
1,4-dimethylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
1,7-dimethylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
1-chloroanthraquinone	16	0.000	0.000	0.000	0.000	0.000	0.000	0
1-chloro-2-nitrobenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
1-chloro-3-nitrobenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
1-methylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
1-methyl-2-isopropyl-naphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
1-pentylheptylbenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2,4,5-trichlorophenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2,4,6-trichlorophenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2,4-dichloronitrobenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2,4-dichlorophenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2,4-dimethylphenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2,4-dinitrophenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0

TABLE A.3 (continued)

PARAMETER	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
2,4-dinitrotoluene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2,6-dinitrotoluene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2,7-dimethylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2-chloroaniline	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2-chloronaphthalene	16	0.250	0.000	0.000	0.000	0.000	0.000	1
2-chlorophenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2-methylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2-methylphenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2-nitroaniline	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2-nitrophenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
2-nitrotoluene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
3,3'-dichlorobenzidine	16	0.000	0.000	0.000	0.000	0.000	0.000	0
3-ehtyl-o-xylene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
3-nitroaniline	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4,5-dimethyl-2-cyclohexen-1-one	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4,6-dinirto-2-methylphenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-bromophenylphenylether	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-chloroaniline	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-chlorophenylphenylether	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-chloro-3-methylphenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-ethyltoluene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-methyldibenzofuran	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-methylphenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-nitroaniline	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-nitrophenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4-nitrotoluene+4-chloraniline	16	0.000	0.000	0.000	0.000	0.000	0.000	0
acenaphthene	16	5.296	0.000	0.000	0.200	0.000	0.500	3
acenaphthylene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
aniline	16	0.000	0.000	0.000	0.000	0.000	0.000	0
anthracene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
benzeneacetaldehyde	16	0.000	0.000	0.000	0.000	0.000	0.000	0
benzidine	16	0.000	0.000	0.000	0.000	0.000	0.000	0
benzoic acid	16	0.000	0.000	0.000	0.000	0.000	0.000	0
benzo(a)anthracene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
benzo(a)pyrene	16	4.531	0.000	0.000	0.000	0.000	0.000	1
benzo(b)fluoranthene	16	6.056	0.000	0.000	0.000	0.000	0.000	1
benzo(g,h,i)perylene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
benzo(k)fluoranthene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
benzyl alcohol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
bis(2-chloroethoxy)methane	16	0.000	0.000	0.000	0.000	0.000	0.000	0
bis(2-chloroethyl)ether	16	0.000	0.000	0.000	0.000	0.000	0.000	0
bis(2-chloroisopropyl)ether	16	0.000	0.000	0.000	0.000	0.000	0.000	0
bis(2-ethylhexyl)phthalate	16	2.277	0.000	0.000	1.450	0.000	3.625	2
bis(2-methylphenyl)diazine	16	0.000	0.000	0.000	0.000	0.000	0.000	0
butylbenzylphthalate	16	0.012	0.000	0.000	0.000	0.000	0.000	1
chrysene	16	0.000	0.000	0.000	0.000	0.000	0.000	0

TABLE A.3 (continued)

PARAMETER	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
chrysene/benz(a)anthracene	16	7.881	1.050	0.000	10.850	0.000	27.125	1
diacetone alcohol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
dibenzofuran	16	0.000	0.000	0.000	0.000	0.000	0.000	0
dibenzo(a,h)anthracene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
diethylbenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
diethylbenzene(2)	16	0.000	0.000	0.000	0.000	0.000	0.000	0
diethylphthalate	16	0.100	0.000	0.000	0.000	0.000	0.000	3
dimethyldibenzofuran	16	0.000	0.000	0.000	0.000	0.000	0.000	0
dimethylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
dimethylnaphthalene(2)	16	0.000	0.000	0.000	0.000	0.000	0.000	0
dimethylphenanthrene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
dimethylphthalate	16	0.000	0.000	0.000	0.000	0.000	0.000	0
di-n-butylphthalate	16	0.812	0.000	0.000	0.600	0.000	1.500	2
di-n-octylphthalate	16	0.000	0.000	0.000	0.000	0.000	0.000	0
ethyltoluene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
fluoranthene	16	5.739	2.350	0.350	5.610	0.000	13.500	2
fluorene	16	0.075	0.000	0.000	0.000	0.000	0.000	3
hexachlorobenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
hexachlorobutadiene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
hexachlorocyclopentadiene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
hexachloroethane	16	0.000	0.000	0.000	0.000	0.000	0.000	0
hydrocarbons-semi-volatiles	16	0.000	0.000	0.000	0.000	0.000	0.000	0
indeno(1,2,3-cd)pyrene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
isophorone	16	0.000	0.000	0.000	0.000	0.000	0.000	0
methylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
methylphenanthrene(2)	16	0.000	0.000	0.000	0.000	0.000	0.000	0
methylphenanthrene(3)	16	0.000	0.000	0.000	0.000	0.000	0.000	0
naphthalene	16	11.612	0.250	0.000	0.950	0.000	2.375	2
nitrobenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
nonylphenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
N-nitrosodiphenylamine	16	1.331	0.000	0.000	0.100	0.000	0.250	3
N-nitrosodi-n-propylamine	16	0.000	0.000	0.000	0.000	0.000	0.000	0
o-toluidine	16	0.000	0.000	0.000	0.000	0.000	0.000	0
pentachlorobenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
pentachlorophenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
pentachlorotoluene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
pentamethylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
phenanthrene	16	3.647	2.050	0.850	3.030	0.000	6.300	3
pyrene	16	4.616	1.950	0.000	4.600	0.000	11.500	2
p-toluidine	16	0.000	0.000	0.000	0.000	0.000	0.000	0
tetramethylbenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
tetramethylbenzene(2)	16	0.000	0.000	0.000	0.000	0.000	0.000	0
tetramethylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
trimethylnaphthalene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
trimethylnaphthalene(2)	16	0.000	0.000	0.000	0.000	0.000	0.000	0
trimethylphenanthrene	16	0.000	0.000	0.000	0.000	0.000	0.000	0

TABLE A.3 (continued)

PARAMETER	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
t-pentylbenzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
(1,2,3-trimethyl)-4-propenyl nap	16	0.000	0.000	0.000	0.000	0.000	0.000	0
(1-methyldodecyl)benzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
(1-methyltridecy)benzene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
(tetramethylbutyl)phenol	16	0.000	0.000	0.000	0.000	0.000	0.000	0
alpha-BHC	16	0.000	0.000	0.000	0.000	0.000	0.000	0
beta-BHC	16	0.020	0.008	0.000	0.014	0.000	0.035	2
delta-BHC	16	0.000	0.000	0.000	0.000	0.000	0.000	0
gamma-BHC	16	0.019	0.000	0.000	0.000	0.000	0.000	3
heptachlor	16	0.000	0.000	0.000	0.000	0.000	0.000	0
aldrin	16	0.000	0.000	0.000	0.000	0.000	0.000	0
heptachlor epoxide	16	0.051	0.005	0.002	0.054	0.000	0.132	3
endosulfan I	16	0.000	0.000	0.000	0.000	0.000	0.000	0
dieldrin	16	0.005	0.000	0.000	0.000	0.000	0.000	2
4,4'-DDE	16	0.034	0.010	0.003	0.050	0.000	0.121	2
endrin	16	0.017	0.000	0.000	0.000	0.000	0.000	1
endosulfan II	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4,4'-DDD	16	0.034	0.010	0.002	0.017	0.000	0.040	2
endrin aldehyde	16	0.000	0.000	0.000	0.000	0.000	0.000	0
endosulfan sulfate	16	0.000	0.000	0.000	0.000	0.000	0.000	0
4,4'-DDT	16	0.127	0.006	0.004	0.023	0.000	0.051	1
methoxychlor	16	0.102	0.012	0.000	0.083	0.000	0.208	2
endrin ketone	16	0.000	0.000	0.000	0.000	0.000	0.000	0
chlordane	16	0.033	0.010	0.007	0.014	0.000	0.025	2
toxaphene	16	0.000	0.000	0.000	0.000	0.000	0.000	0
PCB-1016	16	0.000	0.000	0.000	0.000	0.000	0.000	0
PCB-1221	16	0.000	0.000	0.000	0.000	0.000	0.000	0
PCB-1232	16	0.000	0.000	0.000	0.000	0.000	0.000	0
PCB-1242	16	0.000	0.000	0.000	0.000	0.000	0.000	0
PCB-1248	16	0.368	0.080	0.020	0.550	0.000	1.345	2
PCB-1254	16	0.317	0.056	0.000	0.575	0.000	1.438	1
PCB-1260	16	0.119	0.000	0.000	0.047	0.000	0.118	3
2,4'-DDE	16	0.005	0.000	0.000	0.000	0.000	0.000	3
2,4'-DDD	16	0.005	0.001	0.000	0.004	0.000	0.010	1
2,4'-DDT	16	0.003	0.000	0.000	0.006	0.000	0.015	1
DCPA	16	0.001	0.000	0.000	0.000	0.000	0.000	3
mirex	16	0.026	0.000	0.000	0.006	0.000	0.015	3
alpha-endosulfan	16	0.001	0.000	0.000	0.000	0.000	0.000	3
beta-endosulfan	16	0.018	0.001	0.000	0.011	0.000	0.028	2
zytron	16	0.065	0.010	0.000	0.036	0.000	0.090	2
trifluralin	16	0.005	0.000	0.000	0.000	0.000	0.000	3
chlorobenzilate	16	0.001	0.000	0.000	0.000	0.000	0.000	1
aluminum	15	11346.667	12000.000	10000.000	12500.000	6250.000	16250.000	1
antimony	15	0.000	0.000	0.000	0.000	0.000	0.000	0

TABLE A.3 (continued)

PARAMETER	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
barium	15	96.067	93.000	88.000	105.000	62.500	130.500	1
beryllium	15	0.273	0.000	0.000	0.000	0.000	0.000	1
cadmium	15	1.388	1.100	0.570	1.650	0.000	3.270	1
calcium	15	25333.333	24000.000	21000.000	27000.000	12000.000	36000.000	1
chromium	15	101.733	36.000	20.500	42.000	0.000	74.250	2
cobalt	15	11.933	12.000	11.000	12.500	8.750	14.750	1
copper	15	142.867	55.000	38.000	65.000	0.000	105.500	3
iron	15	26953.333	27000.000	24000.000	30500.000	14250.000	40250.000	2
lead	15	327.067	90.000	65.000	130.000	0.000	227.500	3
magnesium	15	8420.000	9100.000	7500.000	9700.000	4200.000	13000.000	0
manganese	15	580.000	550.000	505.000	635.000	310.000	830.000	1
mercury	16	2.000	0.500	0.300	0.800	0.000	1.550	1
nickel	15	38.200	32.000	30.500	36.500	21.500	45.500	2
potassium	15	1492.000	1400.000	1200.000	1700.000	450.000	2450.000	0
silver	15	0.233	0.000	0.000	0.000	0.000	0.000	1
sodium	15	278.000	140.000	120.000	520.000	0.000	1120.000	0
tin	15	5.533	5.000	0.000	6.500	0.000	16.250	1
vanadium	15	20.467	20.000	18.500	22.000	13.250	27.250	0
zinc	15	235.333	180.000	140.000	235.000	0.000	377.500	3
boron	15	4.760	0.000	0.000	9.100	0.000	22.750	0
lithium	15	26.467	28.000	23.000	29.000	14.000	38.000	1
molybdenum	15	3.653	1.600	1.050	2.850	0.000	5.550	3
strontium	15	41.200	41.000	34.000	43.500	19.750	57.750	1
yttrium	15	10.413	10.000	10.000	12.000	7.000	15.000	1
cyanide	16	1.519	1.350	0.000	1.950	0.000	4.875	1
phenols(4AAP)	16	22.187	0.000	0.000	0.550	0.000	1.375	3

Non-detect values are presented as zero for statistical evaluations.

TABLE A.4

CONTAMINANT CONCENTRATIONS IN BUFFALO RIVER BOTTOM SEDIMENTS
FOR PARAMETERS QUANTIFIED
USACOE - BUFFALO DISTRICT SAMPLING - 1981
(ug/g)

PARAMETER	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
di-2-ethylhexyl phthalate	12	0.000	0.000	0.000	0.000	0.000	0.000	0
di-n-butyl phthalate	12	0.234	0.160	0.000	0.400	0.000	1.000	0
2,4-D isopropyl ester	12	0.000	0.000	0.000	0.000	0.000	0.000	0
hexachlorobenzene	12	0.007	0.000	0.000	0.000	0.000	0.000	1
beta-BHC	12	0.008	0.000	0.000	0.000	0.000	0.000	2
gamma-BHC	12	0.002	0.000	0.000	0.000	0.000	0.000	1
heptachlor	12	0.011	0.010	0.000	0.020	0.000	0.050	0
aldrin	12	0.002	0.000	0.000	0.000	0.000	0.000	1
heptachlor epoxide	12	0.000	0.000	0.000	0.000	0.000	0.000	0
dieldrin	12	0.000	0.000	0.000	0.000	0.000	0.000	0
4,4'-DDE	12	0.002	0.000	0.000	0.000	0.000	0.000	1
endrin	12	0.000	0.000	0.000	0.000	0.000	0.000	0
4,4'-DDD	12	0.000	0.000	0.000	0.000	0.000	0.000	0
4,4'-DDT	12	0.019	0.000	0.000	0.025	0.000	0.062	2
methoxychlor	12	0.010	0.000	0.000	0.000	0.000	0.000	2
PCB-1242	12	0.000	0.000	0.000	0.000	0.000	0.000	0
PCB-1248	12	0.122	0.000	0.000	0.225	0.000	0.562	0
PCB-1254	12	0.438	0.450	0.290	0.555	0.000	0.953	0
PCB-1260	12	0.000	0.000	0.000	0.000	0.000	0.000	0
gamma-chlordane	12	0.012	0.000	0.000	0.030	0.000	0.075	0
DCPA	12	0.096	0.080	0.055	0.110	0.000	0.193	1
2,4'-DDD	12	0.000	0.000	0.000	0.000	0.000	0.000	0
2,4'-DDE	12	0.000	0.000	0.000	0.000	0.000	0.000	0
2,4'-DDT	12	0.017	0.000	0.000	0.030	0.000	0.075	1
alpha-endosulfan	12	0.039	0.000	0.000	0.065	0.000	0.163	1
beta-endosulfan	12	0.000	0.000	0.000	0.000	0.000	0.000	0
isodrin	12	0.003	0.000	0.000	0.000	0.000	0.000	2
mirex	12	0.012	0.000	0.000	0.020	0.000	0.050	0
tetradifon	12	0.000	0.000	0.000	0.000	0.000	0.000	0
trifluralin	12	0.047	0.030	0.000	0.080	0.000	0.200	0
zytron	12	0.000	0.000	0.000	0.000	0.000	0.000	0
aluminum	12	9260.000	8990.000	8755.000	10010.000	6872.500	11892.500	0
arsenic	12	12.408	10.900	9.950	12.800	5.675	17.075	1
cadmium	12	1.333	1.150	1.000	1.500	0.250	2.250	1
chromium	12	35.067	30.350	26.250	36.200	11.325	51.125	1
copper	12	69.550	63.850	56.700	76.300	27.300	105.700	1
iron	12	27737.500	27250.000	26275.000	28550.000	22862.500	31962.500	1

TABLE A.4 (continued)

PARAMETER	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
lead	12	140.258	121.000	94.400	184.500	0.000	319.650	0
manganese	12	484.858	483.500	459.800	510.350	383.975	586.175	0
mercury	12	6.033	0.540	0.365	0.760	0.000	1.353	1
nickel	12	37.367	36.750	35.750	38.750	31.250	43.250	1
zinc	12	392.824	390.700	364.300	476.600	195.850	645.050	1
cyanide	12	0.404	0.331	0.294	0.417	0.109	0.601	3
phenols (4AAP)	12	0.479	0.381	0.244	0.663	0.000	1.292	1

Non-detect values are presented as zero for statistical evaluations.

TABLE A.5

CONTAMINANT CONCENTRATIONS IN BUFFALO RIVER BOTTOM SEDIMENTS
FOR PARAMETERS QUANTIFIED
NYSDEC - SAMPLING - 1983
(ug/g)

PARAMETER	NO. OF SAMPLES	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
fluorene	10	0.237	0.169	0.129	0.261	0.000	0.459	2
phenanthrene	10	2.498	1.686	0.841	2.484	0.000	4.949	1
anthracene	10	0.855	0.579	0.210	0.799	0.000	1.683	1
fluoranthene	10	4.661	4.034	3.329	5.285	0.395	8.219	1
pyrene	10	5.481	3.527	1.999	5.480	0.000	10.702	1
chrysene	10	0.800	0.578	0.359	1.276	0.000	2.652	0
benzo(b)fluoranthene	10	1.709	1.491	0.862	1.992	0.000	3.687	1
benzo(k)fluoranthene	10	0.683	0.647	0.403	0.896	0.000	1.635	0
benzo(a)pyrene	10	1.229	1.163	0.629	1.917	0.000	3.849	0
indeno(1,2,3-cd)pyrene	10	1.539	1.656	0.806	2.049	0.000	3.913	0
dibenzo(a,h)anthracene	10	0.869	0.278	0.147	0.453	0.000	0.912	1
benzo(g,h,i)perylene	10	1.355	1.345	0.717	2.138	0.000	4.269	0
mephenanthrene	10	0.701	0.583	0.352	0.990	0.000	1.947	0
meanthracene	10	0.448	0.400	0.235	0.671	0.000	1.325	0
benzofluorene	10	4.298	4.038	1.267	6.445	0.000	14.212	0
benzathracene	10	1.336	1.139	0.637	2.073	0.000	4.227	0
benzo(e)pyrene	10	3.005	3.726	1.870	4.177	0.000	7.637	0
perylene	10	5.753	4.994	4.513	6.359	1.744	9.128	1

Non-detect values are presented as zero for statistical evaluations.

TABLE A.6

CONTAMINANT CONCENTRATIONS IN BUFFALO RIVER BOTTOM SEDIMENTS
FOR PARAMETERS QUANTIFIED
ERIE COUNTY - SAMPLING - 1985
(ug/g)

PARAMETER	NO. OF SAMPLES [1]	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
acenapthene	58	1.165	0.000	0.000	0.520	0.000	1.300	11
acenapthylene	58	1.332	0.000	0.000	0.538	0.000	1.345	12
anthracene	58	4.091	0.000	0.000	1.793	0.000	4.482	12
benzo(a)anthracene	58	2.184	0.000	0.000	3.290	0.000	8.225	4
benzo(a)pyrene	58	2.056	0.815	0.173	2.777	0.000	6.683	8
benzo(b)fluoranthene	58	1.161	0.266	0.000	1.240	0.000	3.100	10
benzo(g,h,i)perylene	58	1.730	0.295	0.000	2.380	0.000	5.950	6
benzo(k)fluoranthene	58	1.641	0.116	0.000	1.360	0.000	3.400	11
chrysene	58	1.639	0.000	0.000	1.307	0.000	3.268	9
dibenzo(a,h)anthracene	58	1.539	0.122	0.000	1.375	0.000	3.438	8
fluoranthene	58	3.919	0.000	0.000	3.153	0.000	7.883	8
fluorene	58	2.097	0.000	0.000	0.827	0.000	2.067	12
indeno(1,2,3-cd)pyrene	58	2.073	0.583	0.000	3.240	0.000	8.100	2
napthalene	58	4.435	0.000	0.000	0.787	0.000	1.968	9
phenanthrene	58	4.079	0.000	0.000	2.845	0.000	7.113	9
pyrene	58	3.167	0.475	0.000	3.313	0.000	8.283	8
aldrin	58	0.045	0.000	0.000	0.000	0.000	0.000	4
alpha-BHC	58	0.066	0.000	0.000	0.039	0.000	0.098	11
beta-BHC	58	0.119	0.013	0.003	0.067	0.000	0.162	9
gamma-BHC	58	0.000	0.000	0.000	0.000	0.000	0.000	1
2,4'-DDD	58	0.017	0.000	0.000	0.000	0.000	0.000	9
2,4'-DDE	58	0.000	0.000	0.000	0.000	0.000	0.000	0
2,4'-DDT	58	0.015	0.000	0.000	0.000	0.000	0.000	13
4,4'-DDD	58	0.006	0.000	0.000	0.002	0.000	0.004	6
4,4'-DDE	28	0.025	0.008	0.000	0.029	0.000	0.073	4
4,4'-DDT	58	0.003	0.000	0.000	0.004	0.000	0.011	6
dieldrin	58	0.000	0.000	0.000	0.000	0.000	0.000	0
endrin	58	0.007	0.000	0.000	0.000	0.000	0.000	14
heptachlor	58	0.000	0.000	0.000	0.000	0.000	0.000	0
heptachlor epoxide	58	0.059	0.000	0.000	0.031	0.000	0.077	9

TABLE A.6 (continued)

PARAMETER	NO. OF SAMPLES [1]	MEAN	MEDIAN	LOWER FOURTH	UPPER FOURTH	LOWER CUTOFF	UPPER CUTOFF	OUT-LIERS
PCB-1	58	0.449	0.112	0.000	0.401	0.000	1.003	8
PCB-2	58	0.177	0.000	0.000	0.233	0.000	0.583	5
PCB-3	58	0.199	0.062	0.004	0.192	0.000	0.474	7
PCB-4	58	0.421	0.127	0.025	0.296	0.000	0.702	9
PCB-5	58	0.446	0.189	0.068	0.359	0.000	0.797	6
PCB-6	58	0.241	0.078	0.019	0.295	0.000	0.709	4
PCB-7	58	0.343	0.171	0.066	0.318	0.000	0.697	5
PCB-8	58	0.084	0.000	0.000	0.048	0.000	0.119	7
PCB-9	58	0.013	0.006	0.001	0.014	0.000	0.035	5
PCB-10	58	0.105	0.079	0.001	0.157	0.000	0.392	1
PCB-11	58	0.088	0.034	0.000	0.131	0.000	0.327	5
PCB-12	58	0.022	0.011	0.001	0.027	0.000	0.067	5
PCB-13	58	0.010	0.000	0.000	0.014	0.000	0.036	4
PCB-14	58	0.094	0.002	0.000	0.014	0.000	0.035	8
PCB-15	58	0.017	0.000	0.000	0.017	0.000	0.043	6
cadmium	58	2.768	1.691	1.203	3.067	0.000	5.863	4
chromium	58	79.434	28.915	14.700	62.700	0.000	134.700	11
copper	58	128.111	65.533	35.967	124.000	0.000	256.049	8
iron	58	40673.543	32183.333	23333.333	46100.000	0.000	80250.000	5
lead	58	205.644	97.350	47.800	207.433	0.000	446.882	8
manganese	58	719.688	612.666	525.333	743.667	197.832	1071.168	8
mercury	58	1.551	0.475	0.280	1.327	0.000	2.897	7
nickel	58	43.670	38.533	31.700	46.500	9.500	68.700	4
silver	58	0.459	0.308	0.183	0.487	0.000	0.943	6
zinc	58	488.317	288.633	155.000	693.000	0.000	1500.000	3

[1] Number of cores (represent 162 samples)
Non-detect values are presented as zero for statistical evaluations.

THE BUFFALO RIVER DATABASE MANAGEMENT SYSTEM
(Prepared by the Buffalo River Citizens' Committee)

Introduction

The Buffalo River Database was developed by the Buffalo River Citizens' Committee in cooperation with the Department of Environmental Conservation. The objective is to record, organize, analyze, and track information relevant to the condition of the Buffalo River. A series of linked computer data bases contain existing information about the condition of the river generated by the Department's ongoing pollution control programs. Five general types of information were collected: water column monitoring data, sampling information from inactive waste sites, reports of river sediment contamination, discharge permit limits, and locational information linking the various other data sets to specific points on the river.

The integration of these data sets has several significant advantages for persons and organizations who are interested in the condition of the Buffalo River. Centralization of the data greatly improves storage and retrieval of relevant information, which was often difficult to find because it was dispersed in different physical and organizational locations. Volunteers from the Citizens' Committee were able to extract the information from paper records, abstract it, and code it for electronic retrieval. This greatly simplified the task of identifying potential sources of particular pollutants. Coding also increases analytical and graphic capability. Modern relational database management systems permit sophisticated inquiries and powerful graphic displays of data, as described more fully below. Computerization also should facilitate subsequent uses of the database, such as tracking changes over time, transferring data to researchers and other users, and applying more sophisticated analytical software. Later observations can be easily incorporated into the data base, and the updated data set can be shared by disk copy or modem, formatted for use in popular software packages like Lotus and dBASE, and also used as input to more powerful geographic information systems (GIS).

Database Structure

The Buffalo River Database was created in Paradox, a microcomputer-based relational database system. The system is easy to learn, and it has excellent query-by-example facilities that enable the user to perform complex queries. The following data modules were incorporated into the Buffalo River Database:

1. Hazardous Waste Sites. This data module provides the name and street address for each of the inactive hazardous waste sites identified in the Buffalo River watershed. It also includes general facts about each site, including stage of investigation and whether it is located on a 100-year or 500-year floodplain.

2. Inactive Site Parameters. This module summarizes water and soil sampling data, on-site observations, and historical records relating to the contaminants present at each inactive waste site. Most of the data in this module consists of a yes/no listing, indicating whether a specific chemical has been identified as being present at the site. There are approximately 650 records in this module, each representing a unique site and parameter combination.

Quantification of amounts observed has not been included in this version of the database, primarily because of lack of standardization in reporting formats and in sampling and analytical techniques. In addition, narrative notes were included to indicate whether the levels observed were considered hazardous, and to preserve information that did not fit readily into the yes/no format.

3. Discharge Permits. The Permits module summarizes detailed information about each discharger holding a SPDES permit to release water containing pollutants into the Buffalo River or its tributaries. Each entry shows a specific permit limit for a particular discharger, so that it is easy to display all parameters in the permit issued to a particular discharger, or all permittees who are allowed to discharge a specific substance. Quantification of the permitted discharge is included, where appropriate. There are approximately 450 records in this data module.

4. Transects. Locational data is summarized in the Transects data module. Transects are survey lines laid out across the lower river every 100 feet by the Army Corps of Engineers as part of their navigational dredging program. These transects provide a means of integrating the other data sets for a geographic view of the lower river. Sediment samples, discharge outfalls, sewer overflow points, and hazardous waste sites are individually coded by transect location, and identifying information is provided to link the other data modules to the Transects database.

5. Water column Monitoring (In Progress). The Department samples Buffalo River water at the Ohio Street Bridge monitoring station monthly during periods when the water is not frozen, and performs a variety of chemical and physical analyses on the samples. Sampling data for the period from 1982-1986, chosen to represent current conditions on the river, were compiled by Department personnel in a Lotus database. They have not yet been incorporated into the Buffalo River Database.

6. Sediment Samples (In Progress). When completed, this module will contain the date and location of samples, the researcher taking them, and the levels of each contaminant recorded. As in the other modules, each record will represent a unique combination of sample and parameter. The total number of current entries will be slightly less than 300.

Database Queries

Users can query the database either within a single data module, or across several modules simultaneously. Working within single modules, the following types of queries can be rapidly answered:

Permits:

1. List all permittees allowed to discharge cyanide.
2. Are any permittees allowed to discharge both cyanide and phenols?
3. What is the total number of permittees allowed to discharge to the river and its tributaries?
4. What is the flow limit for permittee X?
5. Which permittees discharge to tributary Y?

Site Name:

1. List all inactive waste sites in the Buffalo River watershed, in alphabetical order.
2. List all sites in the 100-year floodplain.
3. What is the street address of site X?
4. In what stage of investigation is site X?

Site Parameters:

1. List the names of all sites where heavy metals were found.
2. List all sites where iron and phenols were found.
3. List all contaminants found at site X.
4. List only the heavy metals found at site X.
5. Were PCBs found at either site X or site Y?
6. Was site X mentioned in the notes for any other site?

While these queries to single data modules can produce useful information, much more detailed and helpful data can be generated by linking different modules through common variables. For example, by linking the site name and site parameter files, a user could find out which inactive waste sites containing phenols are located in the 100-year floodplain, or what the street address is for all sites containing heavy metals.

Perhaps the most valuable queries are geographical views that suggest relationships between pollution sources and impacts. For example, to assess the possibilities for contaminant migration from inactive waste sites into a particular reach of the river, the user could obtain a listing of contaminants identified at all sites located between river transects 500 and 600. similarly, it would be possible to explore the relationships between contamination of the river sediments and direct discharge of pollutants by asking, "What permittees discharge the same substances found in sediment samples taken within 10 transects of their outfalls?" For this query, data from the permits and sediments modules are compared. After contaminant matches are identified, the transects data module determines whether the matches satisfy the geographic limitation.

As additional data sets become available during the implementation of the remedial action plan, it will be possible to add a time dimension to these baseline data sets, and to develop more sophisticated analytical approaches. The system is designed to be flexible, to accommodate new data and data types as knowledge of the Buffalo River grows.

The database information can be graphed using ancillary software. For example, data is easily ported to Lotus 1-2-3 for plotting of simple pie and stacked-bar graphs. Using other software, sophisticated three-dimensional displays and GIS mapping are also possible.

RESPONSIVENESS SUMMARY

Introduction

Two public meetings to receive comments on the draft Buffalo River Remedial Action Plan (RAP) were held by DEC on May 5, 1989 and May 8, 1989, in Buffalo. About 1000 copies of the draft summary report were distributed in the two month period prior to the public meetings. Three workshop sessions were held in April 1989 to review and discuss the draft RAP.

Seventeen organizations or individuals presented comments at the public meetings and an additional 12 submitted comments subsequent to the public meetings. (Table A.7). Many of the comments were editorial and are not included in this responsiveness summary.

Responsiveness Summary

1. Comment: The method of forming the Buffalo River Remedial Action Committee (RAC) should be indicated.

   Response: The Department will be working with existing organizations and interests in the selection of members for the RAC. The RAC will be representative of concerned groups that have an interest in the Buffalo River including government officials, public interest groups, economic interests and private citizens.

2. <u>Comment</u>: The Buffalo River should be divided into an upper and lower section to implement remediation.

   <u>Response</u>: The flow characteristics of the Buffalo River are influenced by lake levels and watershed run-off resulting in two directional water movement in the river. Remedial actions must consider the potential for intermixing of water and sediments between the upper and lower sections.

3. <u>Comment</u>: There is a potential for contaminant leaching with bottom sediment armoring.

   <u>Response</u>: This potential will be evaluated in the remedial design phase, if the armoring alternative is determined to be feasible.

4. <u>Comment</u>: Specific suggestions for habitat improvement along the river were presented by some commentors.

   <u>Response</u>: The suggestions received will be considered in the evaluation and development of a fish and wildlife habitat plan.

5. <u>Comment</u>: There should be a specific time line for the goal of zero discharge.

   <u>Response</u>: While zero discharge is a goal of the U.S. Clean Water Act, the Department does not have the authority to impose a specific time line for its achievement.

6. <u>Comment</u>: Studies related to algae and phytoplankton should be carried out to verify that impairments under indicators 8 and 13 do not exist and to monitor point and nonpoint sources.

Response: Such studies will be considered in the monitoring phase of the remedial program.

7. Comment: Detailed and specific suggestions were presented on remedial actions and monitoring by some commentors.

   Response: These suggestions will be considered in the conduct of the remedial action program.

8. Comment: Modeling activities should be de-emphasized.

   Response: The Department's remedial investigation program recognizes that modeling and field assessment are complimentary. Interpretative models are essential to define field measurement activities necessary for remediation program development.

9. Comment: The relationship between impairment definitions and stream classifications should be clarified.

   Response: The Great Lakes Water Quality Agreement (GLWQA) indicators of water quality impairment are not exactly equivalent to the best uses of the New York State stream classification system. For purposes of the RAP the GLWQA impairment indicators have been used to define impairments. For example, under the GLWQA, restrictions on disposal of dredged spoils are considered an indicator of impaired water quality. This is reported as an impairment for the Buffalo River even though it is not considered as a best use impairment under the NYS stream classification system. In practice, this does not affect the remedial recommendations because contaminated sediments are viewed as a known source of the cause for impairments of five other indicators and a potential source for one more. Remediation of bottom sediments would be recommended even if there were no restrictions on dredge spoil disposal. The text has been modified to provide clarification.

10. Comment: Where better data are needed to assess impairments, the Department should make a commitment to generate the necessary data at an early stage of implementation.

    Response: During the implementation of the RAP, DEC will give careful consideration to acquiring additional data that are clearly needed for the remedial decision process. DEC does not believe that extensive studies to tie down all impairment indicators are warranted or needed before proceeding to correct the known problems.

11. Comment: Additional historical data on the condition of the Buffalo River was provided by one commentor.

    Response: It was not believed necessary to include such historical detail in a plan for future actions.

12. Comment: Dredging would have to stop to allow armoring to work.

    Response: Modifications to current dredging practice will be considered in remedial action program development.

13. Comment: There is a need for quantitative measurements of contaminant loading from the Area of Concern (AOC).

    Response: Reliable loading data from the AOC does not currently exist due to flow reversals in the lower river. The establishment of a flow activated sampling station on the Buffalo River (see Chapter 8) will provide such data.

TABLE A.7
COMMENTORS ON THE DRAFT BUFFALO RIVER
REMEDIAL ACTION PLAN

U.S. Representative Henry J. Nowak

N.Y. State Senator William Stachowski

N.Y. State Assemblyman William B. Hoyt

N.Y. State Assemblyman Francis J. Pordum

Erie County Executive Dennis J. Gorski

City of Buffalo Mayor James D. Griffin

City of Buffalo Councilman Brian Higgins

Ms. Florence Zander
Buffalo Metro League of Women Voters

Ms. Cynthia Schwartz
Erie County Environmental Management Council

Mr. Philip E. Weller
Great Lakes United

Dr. Jill Singer
Assistant Professor, State University College at Buffalo

Mr. David J. Miller
National Audubon Society

Mr. David J. Gianturco, Citizen

Mr. Kenneth Sherman, Citizen Alliance

Mr. Charles H. Fisher III
National Rainbow Coalition

Mr. Anthony Luppino, Citizens' Action

Mr. Edward Krasinski, Citizen

Professor Barry B. Boyer, Esq.
Facility of Law and Jurisprudence
State University of New York at Buffalo

Dr. Lynda H. Schneekloth
Associate Professor, School of Architecture and Planning
State University of New York at Buffalo

Dr. Lester Milbrath, Director
Research Program in Environment and Society
State University of New York at Buffalo

Dr. Brian R. Shero, Professor of Biology
Medaille College

Ms. Beverly Horozko, Citizen

Hodgson, Russ, Andrews, Woods and Goodyear
Attorneys at Law

Mobil Oil Corporation

PVS Chemicals, Incorporated

Erie-Niagara Counties Regional Planning Board

U.S. Army Corps of Engineers, Buffalo District

U.S. Environmental Protection Agency, Region II

U.S. Environmental Protection Agency, Great Lakes National Program Office